E. J. Warwick

U. S. DEPARTMENT OF AGRICULTURE

AGRICULTURAL RESEARCH SERVICE

ANIMAL HUSBANDRY RESEARCH DIVISION

and

COOPERATING WESTERN STATES

W-1 - IMPROVEMENT OF BEEF CATTLE THROUGH THE APPLICATION OF BREEDING METHODS

1960 Annual Report of W-1

and

Report of

Annual Meeting of Technical Committee

Stillwater, Oklahoma

July 25-27, 1960

This report is intended for the use of administrative leaders and workers and is NOT for general publication.

CONTENTS

JOINT MEETING

W-1, NC-1, and S-10 Technical Committees

Oklahoma State University

Stillwater, Oklahoma

July 25, 26, and 27, 1960

Program

July 25

8:30 A.M. Introductions and Announcements

9:00 A.M. Inbreeding and Heterosis in Beef Cattle: Uses of Inbred Lines and Problems of Their Development - Why Use Inbred Lines? - Summary, Outlook, Etc. The representatives of each region will discuss the major research in his region, in each category, including the design of Heterosis and Inbreeding Experiments, etc.

W-1	H. H. Stonaker
NC-1	C. A. Dinkel
S-10	C. M. Kincaid
Discussion Leader	L. N. Hazel

11:30 A.M. Lunch

12:30 P.M. Evaluating the Effectiveness of Selection in Beef Cattle:
A. (1) Germ Plasm Storage, (2) Repeat Mating, (3) Random Bred Controls at One and at Several Locations, (4) Outbred Populations Maintained by Systematic Sampling of the Breeds
C. E. Dickerson

B. How a Random Bred Control Population Might be Operated and Its Usefulness
S. K. Ercanbrack and C. E. Terrill

Discussion Leader T. C. Cartwright

Genetic-Environmental Interactions: Kinds That are Most Likely to be Important With the Present Structure of the Beef Cattle Industry - Design of Experiments for Evaluating Them Including Problems of Selection for Adaptation - Implications in a Breeding Program
J. L. Lush

Discussion Leader Wade C. Rollins

7:00 P.M. Working Together for a More Effective Beef Cattle Breeding Research Program - Storage of Germ Plasm
E. J. Warwick

Discussion Leader Sherman S. Wheeler

July 26

7:30 A.M.	See Identical Twins and Teaching Herds Robert Totusek and Glen Bratcher
8:00 A.M. 10:00 A.M.	Enroute to Fort Reno Livestock Research Station via Chartered Bus
10:00 A.M.	Tour Fort Reno Livestock Research Station
12:00 Noon	Box Lunch
12:30 P.M.	Effect of Feeding Level on the Expression of Maternal Traits in Beef Cattle - Summary of Fort Reno, Stillwater, Beltsville, and Cornell Research L. S. Pope
	Discussion of Results From Different Levels of Feeding in the Breeding Project Doyle Chambers
	Research at the Tennessee Station with Half-Sib Trios at Three Levels of Feeding C. S. Hobbs
	Beef Cattle Breeding Research at the Fort Reno Livestock Research Station - Past, Present, and Future Doyle Chambers
2:30 P.M.	Continue Tour
4:00 P.M.	Return to Stillwater via Chartered Bus

July 27

	W-1 Meeting
8:30 A.M.	Station Reports
11:30 A.M.	Lunch
12:30 P.M.	Business Meeting

Note: The papers presented at the joint meeting are included in the ANNUAL REPORT and PROCEEDINGS OF THE NC-1 TECHNICAL COMMITTEE for 1960.

ANNUAL MEETING

W-1 Technical Committee

Oklahoma State University

Stillwater, Oklahoma

July 27, 1960

J. A. Bennett, Chairman

W-1 Project Leaders Present

Arizona	O. F. Pahnish
California	W. C. Rollins
Colorado	H. H. Stonaker
Hawaii	E. H. Cobb
Idaho	R. E. Christian
Montana	F. S. Willson
Nevada	W. D. Foote
New Mexico	L. A. Holland
Oregon	Ralph Bogart
U. S. Range Livestock Experiment Station	N. M. Kieffer
Utah	J. A. Bennett
Washington	C. C. O'Mary
Wyoming	G. E. Nelms
Regional Administrative Adviser	S. S. Wheeler
Western Regional Coordinator	R. T. Clark
Geneticist	J. S. Brinks
Agricultural Research Service	
Animal Husbandry Research Division	
Beef Cattle Research Branch	E. J. Warwick
State Experiment Stations Division	C. F. Sierk
	M. J. Burris

Dr. Bennett convened the W-1 meeting at 8:30 A.M., Wednesday, July 27. He introduced Dr. James S. Brinks, Agricultural Research Service, Denver, the new committeeman from Wyoming, Dr. George E. Nelms, and Dr. Darryl Foote representing Nevada.

Professor F. S. Willson of Montana and Dr. Estel Cobb of Hawaii were appointed to the resolutions committee.

The chairman called for station reports.

UNIVERSITY OF ARIZONA

I. Station: Arizona Agricultural Experiment Station, Tucson, Arizona

II. Project Title: Breeding and selection of beef cattle for the Southwest

III. Personnel:

Experiment Station:

O. F. Pahnish, leader, L. W. Dewhirst, R. H. Diven, F. E. Hubbert, Jr., A. M. Lane, W. J. Pistor, C. B. Roubicek, E. B. Stanley, and R. E. Taylor

Graduate Students:

T. A. Anderson
N. G. Elliston
D. G. Gill
T. R. Varnell

Cooperators:

Empire Ranch, Sonoita, Arizona
Arivaca Ranch, Arivaca, Arizona
Apache Indian Agency and Apache Tribe, San Carlos, Arizona

Montana Agricultural Experiment Station, Bozeman, Montana
Wyoming Agricultural Experiment Station, Laramie, Wyoming
U. S. Range Livestock Experiment Station, Miles City, Montana

U. S. Department of Agriculture, Agricultural Research Service:

R. T. Clark, Coordinator

IV. Nature and Extent of Work Done This Year:

The cooperative projects with the Empire and Arivaca Ranches and the Apache Indian Tribe were continued as outlined in the revised project plan approved by the W-1 Technical Committee in 1959. The project revision received approval by the State Experiment Stations Division, Agricultural Research Service, on October 15, 1959.

Empire and Arivaca Ranches

Data were collected as in prior years and all data to date have been tabulated and punched for IBM computations.

Statistical analyses of yearling weights and postweaning gains on bull and heifer progeny developed under range conditions to date are in progress.

Results of the analyses of weaning data have been summarized in manuscript form (see Section VIII).

Apache Tribal Herd

Data as described in the project plan have been collected on the 1957 and 1958 calves through 24 months of age and on the 1959 calves through 12 months of age.

Chemical analyses of blood and liver samples taken to date have been completed.

Data for 2,400 IBM cards (data collected during the year) have been tabulated.

Blood and liver vitamin A and carotene values have been analyzed statistically and the results have been summarized in manuscript form (see sections V and VIII.)

Five additional breeding pastures have been developed for future use as required.

Thirteen sires are being used in the 1960 breeding program. Ten of these are involved in the direct progeny comparisons of 8 bulls from 4 Miles City lines and 2 bulls produced in the San Carlos herd. The other three bulls are used in testing the productivity of females sired by Miles City and San Carlos bulls.

V. Summary of Progress and Conclusions to Date:

The calving percentage in the Apache herd (calves born alive/exposed cows in herd during calving season) has continued to increase.

Year	Calving Percentage
1957	68
1958	74
1959	82
1960	89

To investigate the values of plasma vitamin A and carotenoid concentrations as indicators of liver concentrations in range cattle, arithmetic and log functions of liver and plasma vitamin A and carotenoid were correlated in all possible combinations within each of four sampling periods. These data were collected in the Apache herd. The sampling periods are described as follows:

	1957 Progeny				1958 Progeny			
Sampling Period	Age (Days)	Plasma	Liver	Date	Age (Days)	Plasma	Liver	Date
I	213		X	11/6/57	234	X	X	11/13/58
II	372	X	X	4/13/58	337	X	X	2/25/59
III	583	X	X	11/11/58				
IV	689	X	X	2/24/59				

The means and standard deviations by sexes within years and sampling periods are summarized in table 1 and the correlations are summarized in table 2. Subclasses were combined to compute the correlations when variances were found sufficiently homogeneous ($p \geq .05$). Correlations of hepatic vitamin A with plasma vitamin A and hepatic carotene with plasma vitamin A were essentially zero and are not shown in table 2.

The heritabilities of liver and plasma vitamin A and carotene concentrations were computed from data accumulated in the Apache herd. The data used are indicated in the preceding collection summary. The units of measurement are shown in table 1. The heritability estimates derived from paternal half-sib correlations are summarized in table 3.

Although the range in age of calves within sampling periods was as much as 83 days, and age of dam ranged from 3 to 11 years, there was no statistical evidence that these variables had material influence upon any of the vitamin A or carotene concentrations. Heritability estimates were within sexes, and year differences were accounted for by using variances among sires within years in computing each estimate.

Where data were available on both 1957 and 1958 calves, sire × year interactions were tested and were found nonsignificant. Hepatic and plasma vitamin A and carotene concentrations on the progeny of five sires for periods I and II were involved in these analyses.

Application of Findings

Reduction in the size of breeding pastures, removal of shy-breeding cows, and semen tests of sires have resulted in increased calving percentages. These procedures should be effective in general practice.

Under the range conditions to which cattle on the Apache Reservation were subjected, vitamin A stores were never found depleted in any individual animal, and the mean values always were well above the depletion point. This was true even though the animals were maintained on range forage that was largely mature and dry between sampling periods I and II and between sampling periods III and IV. There was, however, a limited amount of green forage growth available at nearly all times. Under the conditions involved, this limited growth, along with prior animal storage, appears sufficient to guard against depletion without supplementation. On the other hand, whether individual vitamin A levels may have reached a low point detrimental to the animals without clear-cut outward manifestations has not been determined as yet. The association of vitamin A concentrations with animal growth and future reproduction will be studied in an endeavor to gain information concerning this matter.

Plasma vitamin A and carotene values were of little value as indicators of hepatic vitamin A concentration. It appears that plasma values should

Table 1.--Means and standard deviations for each sex within year and sampling period

Period	1957		1958	
	Bulls	Heifers	Bulls	Heifers
Hepatic Vitamin A (micrograms per gram)				
Period I	91.75 ± 28.80	103.19 ± 31.52	124.95 ± 31.85	138.13 ± 41.31
Period II	52.45 ± 12.48	50.06 ± 9.05	170.12 ± 49.34	168.08 ± 30.62
Period III	234.28 ± 92.79	181.80 ± 23.75	-	-
Period IV	257.07 ± 60.81	210.13 ± 53.83	-	-
Hepatic Carotenoid (micrograms per gram)				
Period I	5.34 ± 1.45	5.79 ± 1.85	5.63 ± 1.27	6.50 ± 1.77
Period II	9.79 ± 2.88	10.32 ± 2.33	8.84 ± 2.43	8.82 ± 2.47
Period III	10.91 ± 3.57	14.48 ± 2.38	-	-
Period IV	8.39 ± 2.43	8.01 ± 2.42	-	-
Plasma Vitamin A (micrograms per 100 ml.)				
Period I	-	-	45.03 ± 10.98	47.81 ± 12.01
Period II	39.29 ± 17.81	47.29 ± 19.81	56.29 ± 16.10	48.50 ± 12.99
Period III	56.73 ± 13.95	53.64 ± 9.83	-	-
Period IV	64.73 ± 10.60	65.68 ± 9.33	-	-
Plasma Carotenoid (micrograms per 100 ml.)				
Period I	-	-	479.91 ± 44.03	542.26 ± 164.60
Period II	851.29 ±255.79	995.92 ±334.34	556.93 ±191.32	381.73 ± 93.60
Period III	562.77 ±436.04	695.52 ±157.04	-	-
Period IV	631.13 ±174.55	441.00 ±123.55	-	-

Table 2.--Correlation coefficients [a/, b/]

Sample Period	Subclass [c/]	Hepatic Carotenoid (Y) Plasma Carotenoid (X) N	r	Hepatic Vitamin A (Y) Hepatic Carotenoid (X) N	r	Plasma Vitamin A (Y) Plasma Carotenoid (X) N	r	Hepatic Vitamin A (Y) Plasma Carotenoid (X) N	r
Arithmetic (Y) with Arithmetic (X)									
I	57 M&F			142	.290**				
	58 M&F	155	.360**	166	.408**	176	.540**	155	.269**
II	57 M&F	96	.564**			115	-.205*	97	.386**
	58 M&F	146	.399**			173	.600**	146	.272**
	57-58 M&F			256	.170*				
III	57 M&F	96	.291**	106	.222*	105	.199*	96	.115
IV	57 M&F	84	.510**	90	.499**	102	.485**	84	.291**
Logarithmic (Y) with Logarithmic (X)									
I	58 M&F	155	.377**			176	.578**	155	.323**
	57-58 M&F			308	.286**				
II	57 M	54	.968**			115	.169	97	.378**
	57 F	42	.267						
	58 M&F	146	.430**			173	.568**	146	.297**
	57-58 M&F			256	.258**				
III	57 M					60	.090		
	57 F					45	.491**		
	57 M&F	96	.273**	106	.302**			96	.045
IV	57 M&F	84	.551**	90	.516**	102	.494**	84	.331**
Logarithmic (Y) with Arithmetic (X)									
I	58 M&F	155	.381**			176	.561**	155	.293**
	57-58 M&F			308	.268**				
II	57 M&F					115	-.218**	97	.371**
	58 M&F					173	.541**	146	.296**
	57-58 M&F	242	.529**	256	.251**				
III	57 M					60	.032		
	57 F					45	.499**		
	57 M&F	96	.297**	106	.264**				
	57 M&F							96	.060
IV	57 M&F	84	.526**	90	.448**	102	.484**	84	.298**

a/ Hepatic vitamin A and carotenoid reported as micrograms per gram.
b/ Plasma vitamin A and carotenoid reported as micrograms per 100 ml.
c/ Numerals indicate years. M and F indicate male and female, respectively.

* $P < .05$
** $P < .01$

Table 2.--Correlation coefficients [a/, b/] (Continued)

Sample Period	Subclass [c/]	Hepatic Carotenoid (Y) Plasma Carotenoid (X) N	r	Hepatic Vitamin A (Y) Hepatic Carotenoid (X) N	r	Plasma Vitamin A (Y) Plasma Carotenoid (X) N	r	Hepatic Vitamin A (Y) Plasma Carotenoid (X) N	r
		Arithmetic (Y) with Logarithmic (X)							
I	57 M&F			142	.173*				
	58 M&F	155	.359**	166	.232**	176	.546**	155	.291**
II	57 M	54	.900*						
	57 F	42	.267						
	58 M	73	.444**						
	58 F	73	.417**						
	57 M&F					115	.184	97	.385**
	58 M&F					173	.605**	146	.233**
	57-58 M&F			256	.181**				
III	57 M							53	.119
	57 F							43	.001
	57 M&F	96	.263**	106	.260**	105	.211*		
IV	57 M&F	84	.525**	90	.500**	102	.496**	84	.319**

a/ Hepatic vitamin A and carotenoid reported as micrograms per gram.
b/ Plasma vitamin A and carotenoid reported as micrograms per 100 ml.
c/ Numerals indicate years. M and F indicate male and female, respectively.
* $P < .05$
** $P < .01$

Table 3.--Heritability estimates for vitamin A and carotene concentrations

Sex	Sampling Period	D. F. Sires Within Years	D. F. Error	Heritability Estimate
Hepatic Vitamin A				
Bulls	I	16	147	.44
	II	16	117	.20
	III	7	48	1.04
	IV	8	44	1.14
Heifers	I	16	147	.72
	II	16	104	.21
	III	8	41	.76
	IV	8	28	a/
Hepatic Carotene				
Bulls	I	16	146	a/
	II	16	116	.14
	III	7	48	.32
	IV	8	44	.22
Heifers	I	16	126	.35
	II	16	104	1.32
	III	8	41	.05
	IV	8	28	2.08
Plasma Vitamin A				
Bulls	I	8	86	a/
	II	16	128	a/
	III	8	51	a/
	IV	8	43	1.05
Heifers	I	8	73	.25
	II	16	124	.06
	III	8	36	a/
	IV	8	41	a/
Plasma Carotene				
Bulls	I	8	89	.13
	II	16	132	.52
	III	8	53	.16
	IV	8	43	.35
Heifers	I	8	77	.28
	II	16	129	.26
	III	8	37	.29
	IV	8	41	.38

a/ Zero or negative estimate for sire variance. Heritability coefficient not computed.

cattle with hepatic vitamin A concentrations above the depletion point. Even though hepatic vitamin A concentrations may be sufficiently low to justify supplementation when cattle are to be grazed for an additional period on carotene deficient ranges, it is doubtful that such low levels would be reflected adequately by plasma analyses.

The preliminary studies summarized in this report indicated that variations in hepatic vitamin A and carotene concentrations and plasma carotene concentrations of beef cattle are attributable to some degree to gene action. That plasma vitamin A concentration is thus influenced was not demonstrated as consistently. Additional data will be required to clarify the latter point and to increase the accuracy of all estimates. The 95 percent confidence limits for all heritability estimates presented were wide.

VI. Work Planned for the Future:

Empire and Arivaca Ranches

The final data from these ranches under the present program will be collected in September 1960. During the coming year, emphasis will be placed on the analyses of postweaning data and the calculation of correlations among weaning and postweaning traits.

Apache Tribal Herd

Existing procedures will be continued during the coming year. Emphasis will be placed on the analyses of data now available. Analyses of weight and gain data, with an evaluation of Miles City sires, will receive first priority.

VII. Publications and Manuscripts:

Diven, R. H. 1959. Environmental and genetic influences upon hepatic and plasma vitamin A and carotene levels in range cattle. Ph. D. Thesis. University of Arizona. Tucson.

Diven, R. H., O. F. Pahnish, C. B. Roubicek, E. S. Erwin, and H. M. Page. 1960. Vitamin A and carotenoid interrelationships in bovine plasma and liver. (Submitted to J. Dairy Sci.)

Diven, R. H., O. F. Pahnish, C. B. Roubicek, E. S. Erwin, and H. M. Page. 1960. Heritability of liver and plasma concentrations of vitamin A and carotene in the bovine. (Manuscript prepared.)

Pahnish, O. F. 1960. The beef cattle research program at San Carlos, Arizona. Ariz. Agr. Expt. Sta. Feeders' Day (Report). May 21.

Pahnish, O. F., E. B. Stanley, Ralph Bogart, and C. B. Roubicek. 1960. Sex and sire influences upon the 270-day weaning weights of Southwestern range calves. (Manuscript prepared.)

Cattle Inventory
Purebred

PROJECT SUMMARY
Arizona Agricultural Experiment Station

Breed	Hereford	Hereford	Hereford
Line	Empire	Arivaca	Apache
Bulls (12 mos. or over)	36	42	120
Cows (2 yrs. or over)	95	85	366
Heifers, yearlings	39	23	95
Bull calves 1/	-	-	132
Heifer calves 1/	-	-	129
Estimated cash value 2/	$58,000	$54,000	$240,000

1/ Accumulation of records on Empire and Arivaca herds to be discontinued with fall yearling data on 1959 calves.

2/ Cooperative projects. No accurate method of determining percentage of use for breeding project.

Cow Production Data — 1959 calf crop

Breed	Empire Hereford	Arivaca Hereford	Apache Hereford
Cows bred to calve as 2-yr.-olds	-	-	-
Calves born from 2-yr.-olds and up	-	-	-
Cows bred to calve at 3 yrs. and up	93	77	278
Calves born from 3-yr.-olds and up			
Alive	80	64	229
Dead	6	7	5
All calves born			
Alive	80	64	229
Dead	6	7	5
Total	86	71	234
Calves weaned	72	62	190
Percent calf crop			
Birth 1/	86	83	82
Weaning 2/	80	81	72

	Empire Hereford				Arivaca Hereford				Apache Hereford			
	Bulls		Heifers		Bulls		Heifers		Bulls		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Average:												
Birth weight	-	-	-	-	-	-	-	-	118	82	111	78
Weaning age		239		240		249		240		228		231
Weaning weight	33	421	39	409	39	454	23	378	95	486	95	448
Adj. weaning weight	33	488	39	450	39	509	23	419	95	461	95	424
Weaning score 3/												
Cond.	33	10.8	39	11.1	39	11.0	23	10.8	95	9.9	95	10.0
Conf.	33	10.8	39	10.9	39	11.1	23	10.7	95	10.2	95	10.3

1/, 2/, 3/ (see footnotes next page).

1/ Calving percentages based on calves born alive and exposed cows still in herd during calving season.

2/ Weaning percentage based on calves weighed on weaning date and cows in herd during calving season less cows sold before weaning with calves at side.

3/ Score of 10 is low choice feeder grade. Score of 11 is middle choice.

Land, Physical Facilities, and Equipment Used

Item	Number	Actual Cash Value	Percentage Used for Breeding Project 1/
Empire Ranch:			
Land	7 sections	$100,000	
Fencing	18 miles	9,000	
Corrals and scales		4,000	
Water supply		3,000	
Total		$116,000	
Arivaca Ranch:			
Land	7 sections	$100,000	
Fencing	18 miles	9,000	
Corrals and scales		4,000	
Water supply		3,000	
Total		$116,000	
Apache Reservation:			
Land	35 sections	$560,000	
Fencing	55 miles	27,000	
Corrals and scales		4,000	
Water supply		15,000	
Total		$606,000	
Experiment Station:			
Laboratory facilities		$ 20,000	25

1/ Owned by private operators. No accurate method of determining percentage used for breeding project.

UNIVERSITY OF CALIFORNIA

I. Station: California Agricultural Experiment Station, Davis, California

II. Project Title: Breeding experiments to investigate the nature of genetic improvement in beef cattle productivity with special emphasis on the performance of inbred lines and their crosses

III. Personnel:

Experiment Station:
W. C. Rollins, F. D. Carroll, K. Sittman, and A. Nelson

U. S. Department of Agriculture
R. T. Clark, Coordinator

IV. Nature and Extent of Work Done This Year:

Testing bulls directly and by use of progeny for rate of gain, efficiency of gain, and earliness of maturity.

This experiment is continuing according to plan. Currently, 14 bulls have just completed individual feed tests (see table 1). Thirty-five steers are being fed at Davis in the progeny testing of 4 bulls. The last two groups of progeny steers to complete this experiment will be purchased this summer and will complete their test in June 1961.

Data on growth during the suckling period are being gathered in the purebred Hereford herd according to plan.

The double cervix study has been completed and a manuscript submitted to the Journal of Heredity.

The selection index study of weaning weight and weaning grade continues according to the plan outlined in last year's report.

Line, linecross, and topcross comparisons of the California inbred Rover line with various Colorado inbred lines.

The comparison of linecross and inbred bulls in topcross tests in cooperators' herds continues according to plan except that one of the cooperators may sell out this summer following weaning, in which event no data subsequent to weaning would be available.

The comparison of Rover line bulls with bulls of the Colorado Brae Arden and Royal lines in topcrosses and linecrosses at Colorado and at Mississippi continues according to plan.

For results of current Brae Arden × Rover linecross tests at Davis, see tables 1 and 2.

Preparation of manuscripts based on the Brahman-Hereford crossbreeding experiment is nearing completion.

V. Summary of Progress:

The 1957-58 calf crop was composed of Rover line calves sired by bulls 173 and 35 which were full brothers. Postweaning growth data for these calves are presented in table 3. (Erratum: Under V of last year's report the introductory phrase, "The 1957-58 calf crop, etc." should read, "The 1956-57 calf crop, etc.").

The postweaning growth data of the bulls of the 1958-59 calf crop are presented in table 1 as mentioned in IV.

Application of Findings

In the Brahman-Hereford crossbreeding experiment a correlation of -.68 was found between ratio $\frac{\text{round}}{\text{heart girth}}$ (live body measurements of slaughter animals) and the percentage of fat in the 12th rib (total fat, external and interstitial). Ninety-five percent confidence limits are -.83 and -.46. This correlation seems large enough to be of practical significance and it certainly is large enough to warrant further study of this technique as an indicator of fatness in the live animal. It should be noted that the measurements of round and of heart girth are easy to take. Animals of any degree of wildness can be measured readily in a squeeze, and the measurements are not sensitive to a wide range of changes in stance of the animal being measured. The round is measured horizontally from patella to patella. A tape is used for each of the two kinds of measurement.

Studies of rectal temperatures of crossbred Hereford-Brahman and straightbred Hereford calves during ambient temperatures of 90° to 110° F., showed the within-animal variance of rectal temperatures to be twice as great for Herefords as for Hereford-Brahman crossbreds. This information may aid one in designing heat tolerance experiments.

On the basis of a study of a double cervix condition in Hereford cattle, it is concluded that inheritance of this defect is conditioned by a single autosomal recessive gene with low penetrance and variable expressivity. Double cervices seem to occur in most breeds of the bovine species and they have been observed in other classes of livestock. The adverse effect of the double cervix condition on reproductive fitness in Hereford cows is negligible under ordinary beef cattle management.

VI. Work Planned for the Future:

As outlined in the last project revision.

VII. Publications and Manuscripts:

Dunsing, Marilyn. 1959. Visual and eating preferences of consumer household panel for beef from Brahman-Hereford crossbreds and from Herefords. Food Technol. 13(8):451-456.

Wagnon, K. A., and W. C. Rollins. 1959. Heritability estimates of post-weaning growth to long yearling age of range beef heifers raised on grass. J. Anim. Sci. 18:918-924.

Sittman, K., W. C. Rollins, and J. W. Kendrick. 1960. A genetic analysis of the double cervix condition in cattle. (Submitted to J. of Hered.).

Table 1.--University of California yearling bulls tested for rate and efficiency of gain

Weaning to Feed Lot - 143 Days (9/59 - 2/60) Limited Feed, Mainly Roughage Feed-lot Period - 112 Days (2/60 - 5/60) 60% Concentrate, 40% Roughage R = Rover Line; BA = Brae Arden Line											
Type of Mating	Sire No.	Bull No.	Inbreeding of Bull	Actual Weaning Weight	Average Daily Gain Weaning to Feed Lot	Weight at End of Feed-lot Period	Age at End of Feed-lot Period	Average Daily Gain in Feed Lot	Gain in Feed Lot Lbs. TDN/100# Gain	Slaughter Condition at End of Feed-lot Period	U. C. Grade at End of Feed-lot Period
R X R	388	502*	.09	515	1.65	1045	526	2.63	511	Gd	3+
		521	.11	549	1.22	1056	493	2.97	437	Gd	2-
Average			.10	532	1.43	1050	510	2.80	474		
R X R	173	500	.28	431	1.48	940	533	2.65	447	T.Gd.	2
		506	.12	596	1.38	1075	523	2.52	553	Gd +	2-
		508	.14	623	1.66	1200	520	3.04	499	Ch -	2
		516	.28	459	1.45	980	506	2.80	453	Gd +	2
		525	.14	461	1.77	1006	486	2.61	502	Gd	2
		527	.15	545	1.66	1032	484	2.23	602	Gd +	2-
Average			.18	519	1.57	1039	509	2.64	509		
R X R Average			.16	522	1.53	1042	509	2.68	500		
R X (BA X R)	173	531	.07	392	1.87	990	480	2.95	451	Ch -	2
		534	.07	433	1.67	995	476	2.88	431	Ch -	2-
Average			.07	412	1.77	992	478	2.92	441		
BA X R	5012	511	0	603	1.68	1172	512	2.94	487	Ch -	2-
		517	0	692	1.94	1383	505	3.69	442	Ch	2
		528	0	475	1.69	1120	483	3.60	382	Gd +	2
		532	0	553	1.34	1096	478	3.13	438	Ch -	2-
Average			0	581	1.66	1193	494	3.34	437		
Grand average			.09	523	1.60	1078	500	2.90	474		

* Not shown in table 2 because dam raised twins.

Table 2.--Growth to weaning of 1958-59 calves U.C.D. Hereford herd

Weaning Date 9/2/59, Add 64 Pounds to Heifer Calves' Weaning Weight* B = Bull H = Heifer										
Type of Mating	Sire No.	Calf No.	Dam No.	Age of Dam at Calving	W.A.	W.W.	Inb.of Dam	Inb.of Calf	W. Grade	MPPA+
R X R	173	500B	339	4	266	423	.05	.28	3+	-78
		501H	337	4	260	514	.14	.32	2-	-11
		504H	16	10	259	674	.09	.15	1-	54
		506B	214	7	256	584	.11	.12	2	62
		508B	243	6	253	611	.19	.14	2	- 2
		515H	376	3	239	417	.15	.33	3+	-50
		516B	386	3	239	438	.05	.28	2-	-27
		519H	308	5	237	504	.19	.15	2-	- 5
		523H	373	3	220	435	.15	.33	3+	-28
		525B	387	3	219	460	.10	.14	2	-12
		527B	44	12	217	513	.09	.15	2-	23
		533H	350	3	209	467	.13	.32	2	0
		537H	979	12	205	475	.07	.14	2-	-19
Average					237	501	.12	.22		- 7
R X R	388	505H	281	5	257	553	.21	.12	2	-12
		514H	169	9	240	650	.15	.15	2	46
		518H	211	7	237	590	0	.31	2	62
		520H	294	5	232	577	.16	.11	2	47
		521B	19	10	226	526	.11	.11	2	23
		524H	312	4	219	560	.09	.08	2-	20
Average					235	576	.12	.15		31
R X R (173 & 388) Av.					236	525	.12	.20		5

* Weaning was actually on 9/14/59 but this was the last date on which both bulls and heifers were weighed together. In table 1 the actual weaning date is used.

\+ Dam's most probable producing ability.

Table 2.--Growth to weaning of 1958-59 calves U.C.D. Hereford herd (Cont'd)

Weaning Date 9/2/59, Add 64 Pounds to Heifer Calves' Weaning Weight* B = Bull H = Heifer										
Type of Mating	Sire No.	Calf No.	Dam No.	Age of Dam at Calving	W.A.	W.W.	Inb. of Dam	Inb. of Calf	W. Grade	MPPA+
R X (BA X R)	173	529H	424	2	215	425	0	.07	2-	
		530H	440	2	215	489	0	.07	2-	
		531B	400	2	213	378	0	.07	3	
		534B	425	2	209	416	0	.07	3+	
		535H	443	2	209	430	0	.10	3+	
		539H	427	2	194	409	0	.07	2-	
		540H	417	2	191	363	0	.08	3+	
		542H	402	2	187	360	0	.09	3+	
		543H	409	2	184	378	0	.08	3+	
Average					202	405	0	.08		
BA X R	3112	512H	221	6	245	653	.05	0	2+	60
		536H	333	4	208	529	.08	0	2	1
		538H	319	5	202	539	.21	0	2	12
Average					218	574	.11	0		24
BA X R	5012	509H	360	4	250	581	.19	0	2	- 4
		510H	252	5	246	625	.17	0	2+	- 6
		511B	325	3	245	602	.05	0	2	31
		513H	290	5	244	596	.19	0	2	-11
		517B	212	6	238	679	.13	0	2	30
		528B	367	3	216	461	.15	0	3+	-50
		532B	298	5	211	543	.16	0	2-	18
Average					236	584	.15	0		1
BA X R (3112 & 5012) Av.					230	581	.14	0		8
Grand average					227	511	.10			

* Weaning was actually on 9/14/59 but this was the last date on which both bulls and heifers were weighed together. In table 1 the actual weaning date is used.

\+ Dam's most probable producing ability.

Table 3.--University of California yearling bulls tested for rate and efficiency of gain

Weaning to Feed Lot - 149 Days (9/58 - 2/59) Limited Feed, Mainly Roughage Feed-lot Period - 110 Days (2/59 - 5/59) 60% Concentrate, 40% Roughage										
Sire No.	Bull No.	Inbreeding of Calf	240-Day Weaning Weight Adj. for Age of Dam	Average Daily Gain Weaning to Feed Lot	Weight at End of Feed-lot Period	Age at End of Feed-lot Period	Average Daily Gain in Feed Lot	Lbs. TDN/100# Gain in Feed Lot	Slaughter Condition at End of Feed-lot Period	U. C. Grade at End of Feed-lot Period
(Full brothers)										
35	461	.15	415	1.23	952	517	3.20	410	Gd.	2
	462	.13	450	1.21	966	516	2.90	445	T.Gd.	2-
	465	.18	437	1.10	940	514	2.98	444	L.Ch.	2
	466	.15	593	1.29	1103	513	2.83	486	L.Ch.	2
	470	.15	532	0.98	1017	510	3.08	418	Gd.	2
	473	.14	503	1.15	995	509	2.95	459	Gd.	2
	479	.14	486	1.25	1000	505	3.12	431	T.Gd.	2
	489	.16	528	1.19	967	486	3.03	445	Gd.	2
	494	.14	512	1.36	978	483	3.01	437	Gd.	2-
	497	.09	610	1.09	1004	476	3.03	448	Gd.	2
	499	.11	618	0.86	971	460	3.32	376	T.Gd.	2
Av. for 11 head sire group		.14	517	1.16	990	499	3.04	436	L.Ch.-2 T.Gd.-3 Gd. -6	
173	455	.19	489	1.44	1017	523	2.74	502	L.Ch.	2
	471	.17	448	1.40	937	509	2.72	495	T.Gd.	2-
	474	.15	481	1.40	1022	508	2.95	453	L.Ch.	2
	477	.20	564	1.56	1119	506	2.89	475	T.Gd.	2-
	478	.16	506	1.39	1027	506	2.82	487	L.Ch.	2-
	482	.14	469	1.35	1005	502	3.13	434	Gd.	2
	483	.15	414	1.34	896	498	2.85	451	T.Gd.	2
	484	.16	444	1.07	907	492	3.00	444	T.Gd.	2
	485	.16	427	1.19	916	492	3.10	439	L.Ch.	2-
	490	.14	476	1.25	904	486	2.69	460	T.Gd.	2
	493	.19	577	1.00	998	483	3.25	410	T.Gd.	2
	495	.13	454	1.05	889	481	3.14	419	Gd.	2
Av. for 12 head sire group		.16	479	1.29	970	499	2.94	456	L.Ch.-4 T.Gd.-6 Gd. -2	
Grand average		.15	497	1.22	980	499	2.99	446	L.Ch.-6 T.Gd.-9 Gd. -8	

Cattle Inventory PROJECT SUMMARY Date: June 6, 1960

Purebred California Agricultural Experiment Station

Breed	Hereford	Hereford		Hereford
Line	Rover	Rover × Brae Arden		Rover × Brae Arden × Rover
Station	Davis	Davis		Davis
Bulls (12 mos. or over)	25	6		2
Cows (2 yrs. or over)	39	9		-
Heifers, yearlings	8	6		-
Bull calves	16	-		3
Heifer calves	16	-		3
Percentage used for breeding project	100	100		100
Estimated cash value	$38,550	$8,700		$2,375

Grade

Breed	Hereford		Hereford	
Line	Rover		Rover × Grade	
Station	Davis		Davis	
Bulls (12 mos. or over)				
Cows (2 yrs. or over)				
Steer calves		31		
Heifer calves	1			
Percentage used for breeding project				
Estimated cash value	$ 150		$9,500	

Cow Production Data

Breed	Hereford	Hereford	Hereford
Line	Rover	Brae Arden × R. (Artif. Insem.)	Rover × BraeArden × Rover
Cows bred to calve as 2-yr.-olds	3	0	12
Calves born from 2-yr.-olds			
Alive	0	0	9
Dead	1	0	1
Cows bred to calve at 3 yrs. and up	25	23	0
Calves born from 3-yr.-olds and up			
Alive	22	10	0
Dead	1	0	0
All calves born (Alive)	22*1	10	9
Dead	2	0	1
Total	24	10	10
Calves weaned	21*2	10	9
Percent calf crop* (Birth)	71	43	75
Weaning	71	43	75

California Agricultural Experiment Station

Production Data (Continued)

	Rover				Brae Arden × Rover				Rover × Brae Arden × Rover			
	Bulls		Heifers		Bulls		Heifers		Bulls		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Average:												
Birth weight	9	71.6	13	75.8	4	79.8	6	76.7	2	78.5	7	76.3
Weaning age		260		248		249		245		235		237
Weaning weight	8	538	13	529	4	601	6	542	2	433	7	407
Adj. weaning wt. - 180 days		399		418		465		426		346		412

* Please indicate the method used in calculation.

*1 Represents 20 cows; 2 sets of twins.

*2 Represents 20 cows; 1 set of twins carried to weaning.

$$\% \text{ birth} = \frac{\text{No. of cows calving}}{\text{No. of cows exposed}} = \frac{20}{28} \text{ and } \frac{10}{23} \text{ and } \frac{9}{12}$$

$$\% \text{ weaning} = \frac{\text{No. of cows weaning calves}}{\text{No. of cows exposed}} = \frac{20}{28} \quad \frac{10}{23} \quad \frac{9}{12}$$

Feed-lot Performance — Date: June 6, 1960

Breed	Hereford	Hereford
Line	Rover	Rover × Grade
Sex	Bulls	Steers
Number on test	23	31
Average:		Short
Age on test	436 days	yearlings
Initial weight	651	587
Initial score		
Cond.		Feeders
Days on test	110	125
Gain		
Total	329	322
Average	2.99	2.58
Efficiency of feed utilization		
Lbs. TDN/100 Lbs. gain	446.4	549
Final weight	980	909
Final score	L. Ch. 6	
Cond.	T. Gd. 9	
	Gd. 8	Choice
Conf.	2 17	
	2- 6	

California Agricultural Experiment Station

Young Animals on Feed — Date: June 6, 1960

	Number individually fed	Number group fed
Bulls	1	
Steers		35

1/ These animals are currently on feed. Those reported under "Feedlot Performance" were involved in last year's feed trials which were not completed at the time of last year's report.

Land, Physical Facilities, and Equipment Used — Date: June 6, 1960

Item	Number	Actual Cash Value	Percentage Used for Breeding Project
Barns and corrals	3 only	$100,000	75
Irrigated pastures	46 acres		
Dry lots and pastures	14 acres		

I. Station: California Agricultural Experiment Station, Davis, California

II. Project Title: Genetic control of hereditary deficiencies in beef cattle with special emphasis upon dwarfism

III. Personnel:

Experiment Station:

P. W. Gregory, F. D. Carroll, G. P. Lofgreen, L. M. Julian, W. S. Tyler, L. M. Holm, P. C. Kennedy, J. P. Hughes, and Wilmer J. Miller

U. S. Department of Agriculture:

R. T. Clark, Coordinator

IV. Nature and Extent of Work Done This Year:

The routine collection of genetic, anatomical, and other types of data for brachycephalic and dolichocephalic dwarfs, comprest types, and normal cattle has been continued as in the past. This has permitted the establishment of normal values for living animals and their skeletal parts for control, comprest, and for dolichocephalic and brachycephalic mutant dwarf stocks. These values include weight, several linear body measurements of living animals, and specific quantitative or qualitative anatomical characteristics after autopsy. From these characteristics the biological and genetic nature of control and specific mutant stocks are being established in order to determine how each stock may resemble or differ from each of the others.

The analysis of short-headed and long-headed dwarf segregates from the matings that include at least one synthetic comprest parent indicates that these two dwarf types possess essentially similar metacarpals but differ in time of fusion of the spheno-occipital synchondrosis. Thus, both types exhibit achondroplasia, but the achondroplastic expression is different--in the short-headed dwarf expression occurs in both the axial and appendicular skeleton while in the long-headed dwarf the expression is limited primarily to the appendicular skeleton. A high percentage of comprest type animals, subnormal in size, manifest achondroplasia in either the axial or appendicular skeleton or both. A hypothesis of inheritance that accounts for comprest, short-headed, and long-headed dwarf mutants and control stock has been postulated.

Several progeny tests have been completed and others are being continued. The genetic relationship of the Dexter achondroplasia to recessive achondroplasia has been studied.

V. Summary of Progress and Conclusions to Date:

Standards for mature weight, height, and other body measurements have been established for comprest, short-headed, and long-headed dwarf mutants and control. It now is possible to differentiate specific stocks by several body and anatomical characteristics.

The threefold progeny test of Hereford bull 100 upon (a) dwarf carrier cows of normal size, (b) comprest cows, and (c) brachycephalic dwarf cows has been completed. The test progeny were autopsied routinely at death or after slaughter between 12 to 16 months of age, thus permitting classification based upon visual observation of the animal and upon information obtained from autopsy findings. The 19 test progeny from the dwarf-carrier cows were classified by visual evaluation as normal. Classification based upon autopsy findings revealed that 4 of these calves exhibited mild achondroplasia. This indicated that the sire was potentially a dwarf producer. When the bull was mated to comprest cows, he produced 4 calves which were classified by visual means as brachycephalic dwarfs. Anatomical findings confirmed these classifications. Some of his test progeny classified as normal by visual inspection proved to be achondroplastic when anatomical criteria were applied. Ten progeny were produced from dwarf cows, 6 of which were classified by visual inspection as dwarfs. Anatomical inspection later proved them to be achondroplastic. Three of the remaining 4 calves possessed mild achondroplasia. One remained unclassified.

Significant results were obtained from mating short-headed with long-headed dwarfs. When short-headed dwarf bulls were mated to long-headed dwarf cows, none of the progeny resembled either parent but reverted to an intermediate size that resembled comprest. When the reciprocal mating was made, half of the progeny reverted to an intermediate size, while the other half were short-headed dwarfs.

O.S.C. bull 22, which sired a number of small calves at the Oregon station, was progeny tested upon comprest type cows. Most of the test progeny were subnormal in body size and measurements, and some were extremely unthrifty. One was classified as a short-headed dwarf. Classification of all by anatomical criteria will be completed after autopsy. The Oregon report may give additional data on this bull and the characteristics of his line.

A cooperative test involving the New Mexico, Arizona, and California stations is being made to determine if the extreme hydrocephalic lethal condition found in one of the lines at the New Mexico station is related to dwarfism. The bull tested at the California station was mated to comprest and dwarf cows. As yet the test is incomplete, but there is evidence that the bull sired comprest progeny from both comprest and dwarf cows. The significance of the comprest progeny is being investigated further. Reference to this test may occur in the New Mexico and Arizona stations' reports.

The possible relationship of the Dexter achondroplasia to the recessive type of achondroplasia found in beef cattle seemed to be of importance. A registered Dexter bull of typical type was mated to long-headed and short-headed dwarfs, and to small size segregates obtained from experimental matings used to test the relationships of long-headed and short-headed dwarfs, comprest, and compact types. To date the Dexter bull has sired 8 progeny. Two of these were aborted at 7 months of age and proved to be identical with the Dexter bulldog lethal described by Crew. One was abnormal obviously and died the second day. The remaining 5 calves are yet to be classified, but from the extreme conformation exhibited it is suspected that some may develop into "Dexter" and "Kerry" types.

Application of Findings

Most animals that manifest hereditary achondroplasia are subnormal in size but vary in degree and location of expression of achondroplasia. Thus, there are several different morphological forms of achondroplasia. Most may be recognized by inspection or more accurately by objective body measurements and by qualitative or quantitative skeletal characteristics. The achondroplastic components discovered thus far are comprest, compact, long-headed and short-headed dwarfs, and the Dexter achondroplasia. Recognition of the several components of the achondroplastic complex is essential for a valid progeny test for potentiality to produce dwarfs and its control. The several loci associated with the dwarf complex are unique in that one allele of a locus contributes to the vigor and well being of the animal while its partner contributes to achondroplasia or to a specific pattern of achondroplasia. Factor interactions appear to play an important role. There is evidence that deterioration and heterosis are integral parts of the factor interactions. This gene complex also influences the percentage of calves weaned.

VI. Work Planned for the Future:

The work planned for the future falls into two categories: (1) completion and refinement of studies under way, and (2) the publication of researches completed. The studies to be completed are: (a) the analysis of genetic and anatomical relationships of comprest and short-headed and long-headed dwarf mutants to each other and to control stocks; (b) establishing the exact relationship of the Dexter achondroplasia to the different components of the dwarf complex and control stocks; (c) establishing the relationship of the "compact" mutant to the "comprest" and other components of the dwarf complex; (d) completing the anatomical analysis of the test progeny of the O.S.C. bull 22; (e) completing the genetic and anatomical analysis of the New Mexico bull to determine what relationship, if any, there may be between the extreme hydrocephalic lethal condition and the dwarf complex; (f) completing studies now in progress of the relationship of mucopolysaccharides to the different components of the dwarf complex and control stocks.

Much time will be devoted to analysis and publication of the anatomical, genetic, and biochemical findings of completed studies.

VII. Publications and Manuscripts:

Julian, L. M., W. S. Tyler, and P. W. Gregory. 1959. The current status of dwarfism. Amer. Vet. Assoc. J. 135(2):104-109.

Tyler, W. S., L. M. Julian, L. Z. McFarland, H. E. Evans, and P. W. Gregory. 1959. Two projections into the cranial cavity associated with achondroplastic dwarfism in cattle. Amer. J. Vet. Res. 20(77):702-707.

Gregory, P. W., L. M. Julian, and W. S. Tyler. Bovine achondroplasia. 1. Progeny from crossing brachycephalic with dolichocephalic dwarfs. J. Hered. (In press.)

Gregory, P. W., L. M. Julian, and W. S. Tyler. Genetic relationships of some bovine achondroplastic mutants. Twenty-ninth Annu. Meeting, Genet. Soc. of Amer. Okla. State Univ., Stillwater, Okla., August 29-31, 1960. (In press.)

Miller, W. J., and P. W. Gregory. Coat color, pattern, horn condition and blood groups in cattle. Twenty-ninth Annu. Meeting, Genet. Soc. of Amer. Okla. State Univ., Stillwater, Okla., August 29-31, 1960. (In press.)

Gregory, P. W., W. S. Tyler, L. M. Julian, and T. J. Hage. Dwarfs from parents of comprest and normal size. (Manuscript prepared.)

Gregory, P. W., W. S. Tyler, and L. M. Julian. Bovine achondroplasia. 2. The relationship of Dexter achondroplasia to dwarfism. (Manuscript prepared.)

U. C. DWARF HERD INVENTORY
June 14, 1960

	Number	Total
1. Brachycephalic Dwarfs		
Females, breeding age	21	
Females, yearlings	3	
Bulls, mature	2	
Bulls, yearlings	1	27
2. Dolichocephalic Dwarfs		
(Metacarpals similar to Brachycephalic dwarfs)		
Females, breeding age	12	
Females, yearlings	1	
(Metacarpals unlike Brachycephalic dwarfs)		
Females, breeding age	6	
Bulls, mature	1	
Bulls, yearlings	1	21
3. Comprest Type		
Comprest (Descendants of Colorado Domino 68)		
Females, breeding age	8	
Females, yearlings (sired by 409)	6	
Recurrent Comprest		
Females, breeding age	6	
Bulls, mature	1	
Synthetic Comprest		
(Metacarpals similar to Brachycephalic Dwarfs)		
Females, breeding age	3	
Females, yearlings	6	
Bulls, mature	2	
Synthetic Comprest		
(Metacarpals unlike Brachycephalic Dwarfs)		
Females, breeding age	5	37
4. Bulls, Mature		
(Not included anywhere else including Dexter)	4	4
5. To Be Autopsied or Slaughtered		
Cows (when calves are weaned)	11	
Yearlings, female	15	
Yearlings, bull	9	35
6. 1960 Calves on Cows		
Females	16	
Bulls	17	33

COLORADO STATE UNIVERSITY

I. Station: Colorado Agricultural Experiment Station, Fort Collins, Colorado

II. Project Title: Improvement of beef cattle through breeding. A study of inbreeding and the crossing of inbred lines within the Hereford breed

III. Personnel:

Experiment Station:

H. H. Stonaker, Kent Riddle, T. M. Sutherland, T. R. Blackburn, Laura Ann Harris, Ellen A. Norris, R. L. Davenport, Charlene R. Lickley, and K. R. Hartman

U. S. Department of Agriculture: R. T. Clark, Coordinator

IV. Nature and Extent of Work Done This Year, and Summary of Progress and Conclusions to Date:

A. Heritability of calf crop percent in the Ft. Lewis herd was found to be .07 to .08 in a study by Davenport (1959). Crossing of lines has resulted in a 17 percent increase in calf crop over inbreds and 10 percent over controls. These data thus indicate emphasizing hybridizing systems for the genetic improvement of calf crop.

B. The genetic correlations for rate of gain with efficiency of feed use and with mature size of animal has been investigated. The findings indicate a high genetic correlation (-.69) between rate of gain and efficiency. An almost equally high correlation was found between rate of gain and mature size (.64). A low correlation (-.14) existed between mature size and efficiency on feed. It appears that rate of gain selection will thus increase mature size of cattle to about the same degree as it increases efficiency. Selecting directly for mature size (P_m) will serve very readily to increase daily gain $r_{P_M G_G} = .54$ whereas selecting for mature size will have practically no effect on the genotype for efficiency $r_{P_M G_E} = -.12$. A warning is indicated from our data and analysis in selecting on mature size as a short cut means of obtaining greater daily gains, for accomplishment in gains made in this manner will not be noticeably associated with efficiency of feed use (Lickley, 1960).

C. Progenies of Ft. Lewis inbred bulls are being compared at the University of California, Mississippi State University, and Codding Brothers, Foraker, Oklahoma. Current results as reported by these organizations are as follows:

Colorado Agricultural Experiment Station

(a) University of California (taken from table 1 of 1960 California W-1 Report)

Type of Mating	Sire No.	N	Sons F_x	Actual Weaning Weight	Av. Daily Gain Weaning to Feed Lot	Weight at End of Feed-lot Period	Age at End of Feed-lot Period	Av. Daily Gain in Feed Lot	Gain in Feed Lot Lbs. TDN/100 Lbs. Gain
R × R	Rover 388								
	173	8	.16	522	1.53	1042	509	2.68	500
R × (BA × R)	173	2	.07	412	1.77	992	478	2.92	441
BA × R	5012	4	.00	581	1.66	1193	494	3.34	437

	Rover				BA × Rover				Rover × (BA × R)			
	Bulls		Heifers		Bulls		Heifers		Bulls		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Average Birth weight	9	71.6	13	75.8	4	79.8	0	76.7	2	78.5	7	76.3
Weaning age		260		248		249		245		235		237
Weaning weight	8	538	13	599	4	601	6	542	2	433	7	407
Adj. weaning wt. - 180 days		399		418		465		426		346		412

(b) Codding Bros. Test, Foraker, Oklahoma (taken from 112 days' gain on 140-day test; number of progeny per group varies - not reported). Sires from various sources - Ft. Lewis*, University of California, Miles City, and private breeders as well as Codding Bros.

Sires		Initial Weight (Lbs.)	Av. Wt. at End 112-Day Period (Lbs.)	Av. Daily Gain (Lbs.)
San Juan	4026*	627	1059	3.85
Royal	3016*	636	1065	3.83
Prospector	4126*	685	1055	3.30
	B12	579	948	3.29
Monarch	5052*	592	957	3.24
	131	506	868	3.23
Real Prince	4300*	607	966	3.21
Tarrington	6000*	591	932	3.04
	63	565	906	3.04
Miles City	LM 13	476	812	3.00
U. of C.	369	606	942	3.00
	64	526	860	2.98
	4	484	816	2.96
	61	399	730	2.95
Brae Arden	5072*	581	908	2.92
Colorado	6088*	578	905	2.92
Don	5050*	574	895	2.87
	119	457	767	2.77
	140	458	750	2.61
	604	447	735	2.57
	5134	608	889	2.54
	610	479	750	2.42

(c) University of Mississippi

The following tables are taken from the Mississippi station's Annual Report for S-10. Royal 6046, Royal 3016, Brae Arden 6086, Brae Arden 3112, are from the Colorado station. Rover 369 and Rover 310 are from the University of California station.

PERFORMANCE OF COW HERDS--1959 CALVES (Mississippi Station)

Location Line or group Breed of sire Breed of dam	Colo.Royal 6046 Hereford Hereford	Colo.Brae Arden 6086 Hereford Hereford	Calif.Rover 369 Hereford Hereford
No. cows calving	12	16	24
No. calves raised	11	16	22
Av. inbr. of dam (%)	0	0	0
Av. inbr. of calves (%)	0	0	0
Av. birth date	2/24/59	3/4/59	3/22/59
Av. birth wt. (lbs.)	79	71	71
Av. weaning age	226	218	200
Av. weaning wt.*	458.2	423.6	431.8
Av. wean. type score	10.2	10.4	10.3
Av. wean. cond. score	-	-	-
Were calves creep fed?	No	No	No
Adj.1/ av. daily gain from birth to wean.*	1.85	1.72	1.76

1/ Indicate factors adjusted for, i.e., sex, age of dam, etc.

* Weaning weights and daily gains to weaning were adjusted to a mature dam equivalent, for sex, and to a constant age of 205 days.

PERFORMANCE OF COW HERDS--1959 CALVES (Mississippi station) Cont'd

Location	Okla. OK6-60	Poplarville	Montana
Line or group		116	481
Breed of sire	Hereford	Hereford	Hereford
Breed of dam	Hereford	Hereford	Hereford
No. cows calving	22	18	19
No. calves raised	20	17	18
Av. inbr. of dam (%)	0	0	0
Av. inbr. of calves (%)	0	0	0
Av. birth date	3/15/59	3/8/59	3/18/59
Av. birth wt. (lbs.)	73	69	72
Av. weaning age	207	214	204
Av. weaning wt.*	435.8	428.0	439.0
Av. wean. type score	10.0	9.3	9.6
Av. wean. cond. score	-	-	-
Were calves creep fed?	No	No	No
Adj.[1/] av. daily gain from birth to wean.*	1.77	1.75	1.79

1/ Indicate factors adjusted for, i.e., sex, age of dam, etc.

* Weaning weights and daily gains to weaning were adjusted to a mature dam equivalent, for sex, and to a constant age of 205 days.

PERFORMANCE DATA ON YEARLING OR OLDER CATTLE NOT IN BREEDING HERDS IN 1958 1/

Location	Prairie	Prairie	Prairie	Prairie	Prairie
	Colo.Brae	Colo.Royal	Calif.Rover		
Line or group	Arden 3112	3016	310	Bridwell	Natchez
Breed of sire	Hereford	Hereford	Hereford	Hereford	Hereford
Breed of dam	Hereford	Hereford	Hereford	Hereford	Hereford
Sex	M	M	M	M	M
Number	5	5	5	5	5
Initial					
Date	11/12/58	11/12/58	11/12/58	11/12/58	11/12/58
Age (days)	261	265	260	256	260
Weight (lbs.)	369.6	433.2	393.2	484.2	395.2
Score					
Conf.	10.8	11.6	11.3	11.8	10.9
First period					
Feeding regime	winter grazing	same	same	same	same
No. days	190	190	190	190	190
Gain per head	345.2	348.2	330.2	354.8	338.2
Gain per day	1.82	1.83	1.74	1.87	1.78
Second period					
Feeding regime 2/	fattening	same	same	same	same
No. days	116	116	116	116	116
Gain per head	241.6	211.0	230.6	224.8	184.0
Gain per day	2.08	1.82	1.99	1.94	1.59
Final					
Date	9/14/59	9/14/59	9/14/59	9/14/59	9/14/59
Age	567	571	566	562	566
Weight	956.4	992.4	954.0	1063.8	900.8
Score					
Cond.	11.0	10.8	11.0	11.0	10.8
Gain per day of age	1.69	1.74	1.68	1.89	1.59

1/ Include here cattle finished on pasture and/or in dry lot on which there was more than one postweaning test period. Details on feeding methods in different periods should be added as footnotes where needed.

2/ Steers were full fed a ration of 2/3 ground shelled corn and 1/3 ground oats plus cottonseed meal.

DATA ON ANIMALS SLAUGHTERED (Mississippi Station)

Location	Prairie	Prairie	Prairie	Prairie	Prairie
	Colo.Brae	Colo.Royal	Calif.Rover	Bridwell	Natchez
Line or group	Arden 3112	3016	310		
Breed of sire	Hereford	Hereford	Hereford	Hereford	Hereford
Breed of dam	Hereford	Hereford	Hereford	Hereford	Hereford
Sex	M	M	M	M	M
No. slaughtered	5	5	5	5	5
Age at slaughter	567	571	566	562	566
Time in feed lot	116	116	116	116	116
Gain in feed lot	2.08	1.82	1.99	1.94	1.59
Final feed-lot weight	956.4	992.4	954.0	1063.8	900.8
Slaughter weight	947.0	990.0	943.0	1059.0	915.0
Carcass weight	589.4	628.6	592.0	665.2	566.0
Dressing percentage 3/	61.6	63.3	62.0	62.5	62.8
Slaughter grade	11.0	10.8	11.0	11.0	10.8
Carcass grade	9.4	9.6	9.2	9.4	9.4
Fat thickness over rib eye	0.87	0.69	0.71	0.64	0.71
Rib eye area	10.49	10.83	10.49	11.55	9.90
Marbling score	8.8	8.6	8.0	8.2	8.2
Other observations on carcass:					
Carcass length	45.36	47.06	46.56	47.72	45.34
Leg length	29.08	29.54	29.32	30.30	28.60
Circumference of round	33.48	32.68	34.48	35.72	33.14
Width of round	10.34	10.40	10.16	10.52	10.18
Loin length	23.90	24.34	25.98	25.12	23.92
Width of chest	8.32	8.88	8.42	8.77	7.99
Depth of chest	16.59	16.36	16.79	17.19	16.70

1/ Steers were weighed off feed during early morning, loaded on trucks, and hauled to slaughter plant and killed at 1:00 p.m., on same day.

2/ Hot weight used.

3/ Final feed-lot weights and hot carcass weights were used to calculate the dressing percentage.

4/ 1 through 12 according to USDA standards, with 1 extremely abundant and 12 void.

VI. Work Planned for the Future:

Complete administrative responsibility for the Ft. Lewis farm and ranch has been given to the Colorado Agricultural Experiment Station. This may lead to a somewhat expanded breeding research program. Analyses currently under way involve studies of blood types and performance.

VII. Publications and Manuscripts:

Davenport, R. L.
1959. Heritability of reproductive performance in beef cattle. M. S. Thesis. Colorado State University. Fort Collins.

Davenport, R. L., H. H. Stonaker, T. M. Sutherland, and K. H. Riddle
1959. Heritability of reproductive performance in beef cows. (Abs. 8.) J. Anim. Sci. 18(4):1463.

O'Bleness, G. V., H. H. Stonaker, and C. R. Henderson
1959. The combining abilities of thirteen inbred lines of Hereford cattle. (Abs. 15.) J. Anim. Sci. 18(4):1466.

Stonaker, H. H.
1959. Size as a factor influencing productivity in beef cattle. Tex. Livestock J. 18(10):6,58.

Colorado Agricultural Experiment Station
1960. Beef cattle improvement day and auction. May 28. Colo. Agr. Expt. Sta. Gen. Ser. Paper 731.

Lickley, Charlene R.
1960. Relationship between mature size, daily gain, and efficiency of feed utilization in beef cattle. M. S. Thesis. Colorado State University. Fort Collins.

Lickley, Charlene R., H. H. Stonaker, T. M. Sutherland, and Kent Riddle
1960. Relationship between mature size, daily gain, and efficiency of feed utilization in beef cattle. Amer. Soc. Anim. Prod. West. Sect. Proc. 11:IX-1-6.

Stonaker, H. H.
1960. Improving the breeding herds. Amer. Cattle Prod. 41(9):10.

Cattle Inventory PROJECT SUMMARY
Purebred Colorado Agricultural Experiment Station 5-24-60

Breed	Hereford					
Line	Bonanza	Brae Arden	Colorado	Don	Monarch	Prospector
Bulls (12 mos. or over)	1+7	3+12	2+0	1+4	1+2	0+6
Cows (2 yrs. or over)	13	30	11	15	18	16
Heifers, yearlings	2	10	0	2	1	7
Bull calves	0	10	3	1	8	6
Heifer calves	5	10	0	7	8	7
Percentage used for breeding project	100	100	100	100	100	100
Estimated cash value						

Breed	Hereford					
Line	Real Prince	Rover	Royal	San Juan	Tarrington	
Bulls (12 mos. or over)	1+3	0+6	3+6	3+6	1+8	
Cows (2 yrs. or over)	7	0	18	18	4	
Heifers, yearlings	1	7	4	10	7	
Bull calves	3	5	8	4	6	
Heifer calves	5	4	5	5	3	
Percentage used for breeding project	100	100	100	100	100	
Estimated cash value						

Breed	HXA-Sh.					
Line	Cross-bred	Control	Model Domino	On Lease		
Bulls (12 mos. or over)	0+2	2+5	0+3	7		
Cows (2 yrs. or over)	11	11	0	155		
Heifers, yearlings	0	3	2	13		
Bull calves	7	8	0	-		
Heifer calves	2	4	0	-		
Percentage used for breeding project	100	100	100	100		
Estimated cash value						

1959 Calving

Cow Production Data Colorado Agricultural Experiment Station

Breed	Hereford	Hereford	Hereford
Line	Bonanza	Brae Arden	Colorado
Cows bred to calve as 2-yrs.-olds	2	1	2
Calves born from 2-yr.-olds			
Alive	0	0	1
Dead	1	1	1
Cows bred to calve at 3 yrs. and up	12	28	13
Calves born from 3-yr.-olds and up			
Alive	10	22	11
Dead	-	2	1
All calves born			
Alive	10	22	12
Dead	1	3	1
Total	11	25	13
Calves weaned	10	22	12
Percent calf crop			
Birth	78.5	89.3	86.6
Weaning	71.4	78.5	86.6

	Bulls		Heifers		Bulls		Heifers		Bulls		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Average:												
Birth weight	-	-	-	-	-	-	-	-	-	-	-	-
Weaning age	189		184		193		178		191		202	
Weaning weight	382		390		429		383		427		447	
Adj. weaning wt. - 200 days	470		512		490		513		477		501	

1959 calving

Cow Production Data Colorado Agricultural Experiment Station

Breed	Hereford	Hereford	H × A.Sh.
Line	Don	Control	Crossbreds
Cows bred to calve as 2-yr.-olds	1	-	-
Calves born from 2-yr.-olds			
Alive	1	-	-
Dead	-	-	-
Cows bred to calve at 3 yrs. and up	19	12	9
Calves born from 3-yr.-olds and up			
Alive	16	11	6
Dead	-	-	-
All calves born			
Alive	17	11	6
Dead	-	-	-
Total	17	11	6
Calves weaned	17	10	6
Percent calf crop			
Birth	85.0	91.6	66.6
Weaning	85.0	83.3	66.6

	Bulls		Heifers		Bulls		Heifers		Bulls		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Average:												
Birth weight	-	-	-	-	-	-	-	-	-	-	-	-
Weaning age	193		202		192		190		190		211	
Weaning weight	466		418		449		373		455		506	
Adj. weaning wt. - 200 days	512		452		468		412		484		521	

1959 Calving

Cow Production Data Colorado Agricultural Experiment Station

Breed	Hereford	Hereford	Hereford
Line	Model Domino	Monarch	Prospector
Cows bred to calve as 2-yr.-olds	-	-	1
Calves born from 2-yr.-olds			
Alive	-	-	1
Dead	-	-	-
Cows bred to calve at 3 yrs. and up	5	17	13
Calves born from 3-yr.-olds and up			
Alive	4	11	9
Dead	-	1	-
All calves born			
Alive	4	11	10
Dead	-	1	-
Total	4	12	10
Calves weaned	4	11	10
Percent calf crop			
Birth	80.0	66.6	71.4
Weaning	80.0	61.1	71.4

	Bulls		Heifers		Bulls		Heifers		Bulls		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Average:												
Birth weight	-	-	-	-	-	-	-	-	-	-	-	-
Weaning age	199		189		201		192		193		203	
Weaning weight	390		320		408		394		450		431	
Adj. weaning wt. - 200 days	405		373		464		469		521		497	

1959 Calving

Cow Production Data Colorado Agricultural Experiment Station

Breed	Hereford	Hereford	Hereford
Line	Real Prince	Rover	Royal
Cows bred to calve as 2-yr.-olds	-	-	1
Calves born from 2-yr.-olds			
Alive	-	-	
Dead	-	-	1
Cows bred to calve at 3 yrs. and up	10	-	16
Calves born from 3-yr.-olds and up			
Alive	6	-	10
Dead	1	-	1
All calves born			
Alive	6	-	10
Dead	1	-	2
Total	7	-	12
Calves weaned	6	-	10
Percent calf crop			
Birth	70.0	-	70.5
Weaning	60.0	-	58.8

	Bulls		Heifers		Bulls		Heifers		Bulls		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Average:												
Birth weight	-	-	-	-	-	-	-	-	-	-	-	-
Weaning age	214		199		-		-		173		206	
Weaning weight	448		255		-		-		398		405	
Adj. weaning wt. - 200 days	511		383						485		429	

1959 Calving

Cow Production Data Colorado Agricultural Experiment Station

Breed	Hereford	Hereford	Hereford
Line	San Juan	Tarrington	La Plata
Cows bred to calve as 2-yr.-olds	1	1	-
Calves born from 2-yr.-olds			
Alive	1	1	-
Dead	-	-	-
Cows bred to calve at 3 yrs. and up	18	7	6
Calves born from 3-yr.-olds and up			
Alive	15	4	5
Dead	-	1	-
All calves born			
Alive	16	5	5
Dead	-	1	-
Total	16	6	5
Calves weaned	16	5	5
Percent calf crop			
Birth	84.2	75.00	83.3
Weaning	84.2	62.50	83.3

	Bulls		Heifers		Bulls		Heifers		Bulls		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Average:												
Birth weight	-	-	-	-	-	-	-	-	-	-	-	-
Weaning age	200		198		199		180		185		193	
Weaning weight	507		424		500		328		457		388	
Adj. weaning wt. - 200 days	534		508		523		491		486		433	

1959 Calving

Cow Production Data Colorado Agricultural Experiment Station

Breed	Hereford	Hereford	Hereford
Line	Verde	Mesa	Fort Lewis
Cows bred to calve as 2-yr.-olds	-	-	-
Calves born from 2-yr.-olds			
Alive	-	-	-
Dead	-	-	-
Cows bred to calve at 3 yrs. and up	12	3	7
Calves born from 3-yr.-olds and up			
Alive	4	3	6
Dead	-	-	1
All calves born			
Alive	4	3	6
Dead	-	-	1
Total	4	3	7
Calves weaned	4	3	6
Percent calf crop			
Birth	33.3	100.0	100.0
Weaning	33.3	100.0	85.7

	Bulls		Heifers		Bulls		Heifers		Bulls		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Average:												
Birth weight	-	-	-	-	-	-	-	-	-	-	-	-
Weaning age	193		213		-		207		201		211	
Weaning weight	455		380		-		398		415		446	
Adj. weaning wt. - 200 days	467		410		-		417		413		477	

Date: 5-19-60

Feed-lot Performance Colorado Agricultural Experiment Station

Breed	Hereford	Angus	Shorthorn	Crossbred
Sex	Bulls	Bulls	Bulls	Bulls
Number on test	94	3	2	2
Average:				
Age on test	-	-	-	-
Initial weight	434.0	542.3	485.5	468.0
Days on test	140	140	140	140
Gain per head				
Total	350.0	351.7	360.5	359.0
Average daily gain	2.50	2.51	2.57	2.56
Efficiency of feed utilization				
Lbs. TDN/100 lbs. gain	6.63	7.42	7.50	7.13
Final weight	784	894	846	827
Final score				
Conf.	4.8	6.0	6.0	4.8

Young Animals on Feed

Purebred

Date: 5-19-60

	Hereford	Angus	Shorthorn
	Number individually fed	Number individually fed	Number individually fed
Bulls	94	3	2
Heifers			
Steers			
Grades - Crossbred (H × Angus - Shorthorn)			
Bulls	2		
Heifers			
Steers			

UNIVERSITY OF HAWAII

I. Station: Hawaii Agricultural Experiment Station, Honolulu, Hawaii

II. Project Title: The estimation of genetic and phenotypic parameters in populations of beef cattle in Hawaii and their use in selection programs

III. Personnel:

Experiment Station:

Estel H. Cobb, Oliver Wayman, Kenneth Otagaki, Isaac Iwanaga, and Valentino Arganosa (also managers of each cooperating ranch and their stock handling personnel)

U. S. Department of Agriculture:

R. T. Clark, Coordinator

IV. and V. Nature and Extent of Work Done This Year, and Summary of Progress and Conclusions to Date:

Weights and conformation scores at weaning, 12 months, and 20 months of age were obtained as planned.

Forty-one steers from seven sires were selected at weaning and castrated for progeny testing for carcass characteristics.

One bull that was diagnosed as a questionable breeder on the basis of semen testing was bred to 30 cull heifers. He had no offspring. His semen was characterized by low motility and quite a number of tailless sperm.

Coefficients of correlation between the area of rib eye muscle taken between the 12th and 13th rib and other carcass traits were calculated on 40 steer carcasses. Correlations were calculated on a within-lot basis. No adjustments were made for differences in body weight.

	Average External Fat Thickness Over Rib Eye Muscle	Carcass Specific Gravity	Body Weight	Carcass Grade
Area of rib eye muscle between 12th and 13th rib	-0.27	-0.02	0.07	0.13
Average external fat thickness over rib eye muscle	-	-0.51	0.31	0.37

Coefficients of correlation between tenderness, flavor, and juiciness scores and the number of chews required to completely masticate a 1" × 1" × 3/8" piece of meat were calculated. The data included 60 rib roasts that were roasted under controlled conditions and scored by a panel of 8 judges. Only U. S. Standard and U. S. Choice grades of beef were represented.

Traits	Juiciness Score	Flavor Score	Number of Chews Required to Completely Masticate Sample
Tenderness score	.77 1/	.66	-.71
	.68 2/	.51	-.46
Juiciness score		.53	-.65
		.27	-.36
Flavor score			-.62
			-.40

1/ Upper figures are total correlations
2/ Lower figures are correlations based on sums of squares and cross-products that were pooled within subclasses.

Further work was done during the year on the relationship between weights and conformation scores at 8, 12, and 20 months of age. A manuscript on this material is in the final stages of preparation.

Considerable time was spent during the year in developing pastures, feeding pens, holding pens, and meats laboratory facilities at the new Waialee Livestock Research Farm. The farm will be occupied late in the summer of 1960.

VI. Work Planned for the Future:

The analysis of data will continue. Manuscripts on the effects of age of dam, sex, and age of calf on weanling traits of beef cattle, and the relationships between weights and conformation scores at 8, 12, and 20 months of age in beef cattle will be submitted for publication. Heritabilities of weights and conformation scores at weaning, 12 months, and 20 months of age will be calculated.

Feed-lot and carcass work on test steers will be started in August 1960.

VII. Publications and Manuscripts:

None.

Cattle Inventory PROJECT SUMMARY Date: June 1960
Purebred Hawaii Agricultural Experiment Station

Breed	Hereford	Hereford	Hereford
Line	Kaalualu	Kapapala	Martin
Station	Hawaii	Hawaii	Hawaii
Bulls (12 mos. or over)	3	3	3
Cows (2 yrs. or over)	-	-	20
Heifers, yearlings	-	-	-
Bull calves	-	-	6
Heifer calves	-	-	7
Percentage used for breeding project	100	100	100
Estimated cash value	$2,100	$2,100	$23,000

Grade

Breed	Hereford	Hereford	Hereford	Hereford
Line	Kaalualu	Kapapala	Kaalualu × Kapapala	Martin topcrosses
Station	Hawaii	Hawaii	Hawaii	Hawaii
Bulls (12 mos. or over)	44	21	11	-
Cows (2 yrs. or over)	241	102	-	-
Steer yearlings	35	6	-	-
Heifer yearlings	97	30	18	-
Bull calves	30	31	45	28
Heifer calves	37	19	49	24
Percentage used for breeding project	100	100	100	100
Estimated cash value	$127,800	$53,500	$11,000	$6,000

Cow Production Data

Breed	Hereford	Hereford	Hereford
Line	Kaalualu[2/]	Kapapala[2/]	Kapapala × Kaalualu[3/]
Cows bred to calve at 3 yrs. and up	260	91	
All calves born			
Alive	208	88	
Dead	4	1	
Total	212	89	
Percent calf crop[1/]			
Birth	80.0	96.7	

Cow Production Data (Cont'd) Hawaii Agricultural Experiment Station

	Hereford				Hereford			
	Bulls		Heifers		Bulls		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Average:								
Weaning age	258		269		255		256	
Weaning weight	76	437	94	404	29	382	30	363
Adj. weaning wt. - 240 days	400		382		363		346	
Weaning score								
Conf.	76	3.9	94	4.4	29	3.5	30	3.8

	Hereford			
	Bulls		Heifers	
	No.	Av.	No.	Av.
Average:				
Weaning age	258		260	
Weaning weight	17	415	24	393
Adj. weaning wt. - 240 days	392		369	
Weaning score				
Conf.	17	3.9	24	4.4

1/ Based on number of calves alive and number of cows exposed to bull
2/ Refers to line in bottom part of table
3/ Refers to breeding of calves for bottom part of table

Feed-lot Performance - None.

Young Animals on Feed Date: June 1960

Forty-one yearling steers from seven sires are scheduled to go on test in the summer of 1960. One-half of each sire group will be fed out on pasture, and the other half will be individually fed a fattening ration. All of the animals will be slaughtered at about 1,000 pound live weight.

Land, Physical Facilities, and Equipment Used Date: June 1960

Item	Number	Actual Cash Value	Percentage Used for Breeding Project
Land (Kaalualu)	1,150 acres	$12,600.00	100% Annual lease value
Corrals and chutes	1 set	2,400.00	100%
Portable scale	1 only	650.00	80%
Land (Kapapala)	924 acres	10,123.00	100% Annual lease value
Corrals, chute, scale	1 set	3,300.00	100%
University of Hawaii			
Portable scale	1 only	720.00	100%
Profilometer	1 set	200.00	100%
Leica camera set	1 only	613.10	50%
Electric ejaculator	1 only	543.74	100%
Monroe adding machine	1 only	238.18	65%
Friden calculator	1 only	658.75	80%
Total value		$32,046.77	

UNIVERSITY OF IDAHO

I. Station: Idaho Agricultural Experiment Station, Moscow, Idaho

II. Project Title: The improvement of beef cattle through: (1) linebreeding within the Hereford and Shorthorn breeds, (2) testing linebred sires within the various lines which will be developed, and (3) determining the relative importance of various reproduction phenomena

III. Personnel:

Experiment Station:
R. E. Christian, C. W. Hodgson, T. D. Bell, and S. E. Slyter

U. S. Department of Agriculture:
R. T. Clark, Coordinator

IV. and V. Nature and Extent of Work Done This Year and Summary of Progress and Conclusions to Date:

Performance and production data have been collected according to the project outline.

Since the breeding policy of the University of Idaho is to buy purebred replacement bulls and to save replacement heifers from within the herd, the individual feeding program has been changed to individual feeding of heifer calves. Seventeen heifer calves (11 Herefords, 3 Angus, and 3 Shorthorns) were individually fed for 140 days following weaning to obtain feed-lot gain and feed efficiency. The average daily gain for the 11 Herefords was 1.22 pounds, for the 3 Angus, 1.19 pounds, and for the 3 Shorthorns, 1.17 pounds. The correlation between initial type score and rate of gain in the feed lot was 0.298 which would indicate that while of some value, the association is not sufficiently close that type can be used with much accuracy in predicting feed-lot gain in heifers.

Cow production data for the period 1959-60 are now being summarized to obtain correction factors for use in the University herd and to provide additional data on the heritability of production traits. These results will not be available until the analysis is completed.

Additional data have been collected on the insulin-shock technique for detecting dwarfism using known dwarf-carrier and pedigree-clean cows. No definite pattern has been shown by either group. It would appear that this technique is of little value in detecting dwarf-carrier cows in one herd.

The State of Idaho has not had a very active production testing program for the purebred and commercial cattle breeders. This year a program

has been initiated in cooperation with the extension service. To date 20 purebred and commercial breeders have been enrolled. The first calves will be weaned this fall.

Application of Findings

The average purebred and commercial beef cattle breeder in the State of Idaho purchases breeding bulls from outside sources and selects replacement heifers from within his own herd. This practice needs further investigation to determine what improvement can be made in performance using this procedure. To improve the accuracy of selection, correction factors to correct for age of dam, age at weaning, sex, etc., are needed for use in the State of Idaho. These will be obtained from the data available in the University of Idaho herd.

VI. Work Planned for the Future:

The practice of semen testing beef bulls for breeding soundness has become widespread in Idaho. An electro-ejaculator has been purchased recently by the University of Idaho for studies on semen testing. All of the bull calves from the 1960 calf crop will be used to determine the age at which it is first possible to obtain semen with an electro-ejaculator. Routine collections will be made to ascertain changes in semen quality with age.

The analysis of the cow production data will be continued to obtain correction factors for use in the University herd as well as to contribute information on the heritability of various production traits.

The state-wide production testing program will be expanded to include more purebred and commercial breeders.

VII. Publications and Manuscripts:

Christian, R. E. Age at puberty and related phenomena in the beef heifer. (Manuscript prepared.)

Cattle Inventory PROJECT SUMMARY
Purebred Idaho Agricultural Experiment Station Date: 6-15-60

Breed	Hereford	Angus	Shorthorn
Line	-	-	-
Station	Main	Main	Main
Bulls (12 mos. or over)	13	3	4
Cows (2 yrs. or over)	59	23	22
Heifers, yearlings	11	5	7
Bull calves	23	7	9
Heifer calves	25	6	11
Percentage used for breeding project	75	75	75
Estimated cash value	$45,000	$18,000	$21,000

Grade

Breed	Hereford
Line	-
Station	Main
Bulls (12 mos. or over)	1
Cows (2 yrs. or over)	8
Steer calves	11
Heifer calves	5
Percentage used for breeding project	100
Estimated cash value	$4,000

Cow Production Data

Breed	Hereford	Angus
Cows bred to calve as 2-yr.-olds	0	0
Calves born from 2-yr.-olds		
Alive	0	0
Dead	0	0
Cows bred to calve at 3 yrs. and up	61	21
Calves born from 3-yr.-olds and up		
Alive	50	13
Dead	1	0
All calves born		
Alive	50	13
Dead	1	0
Total	51	13
Calves weaned	46	13
Percent calf crop (birth)	82.0	61.9
Weaning	75.4	61.9

Cow Production Data (Continued)

	Hereford				Angus			
	Bulls		Heifers		Bulls		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Average:								
Birth weight	25	73.2	26	67.8	6	60.7	7	55.3
Weaning age		167.6		168.3		177.7		174.1
Weaning weight	22	391.9	24	358.7	6	368.3	7	330.7
Weaning score	22	3.7	24	4.5	6	2.7	7	4.0

Cow Production Data (Continued)

Breed	Shorthorn			
Cows bred to calve as 2-yr.-olds	0			
Calves born from 2-yr.-olds				
Alive	-			
Dead	-			
Cows bred to calve at 3 yrs. and up	20			
Calves born from 3-yr.-olds and up				
Alive	18			
Dead	0			
All calves born				
Alive	18			
Dead	0			
Total	18			
Calves weaned	18			
Percent calf crop				
Birth	90.0			
Weaning	90.0			

	Bulls		Heifers		Bulls		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Average:								
Birth weight	7	70.0	11	62.5				
Weaning age		177.9		173.7				
Weaning weight	7	411.1	11	334.2				
Weaning score	7	4.0	11	5.5				

Feed-lot Performance Idaho Agricultural Experiment Station 6-15-60

Breed	Hereford	Angus	Shorthorn
Line	-	-	-
Sex	F	F	F
Number on test	11	3	3
Average:			
Age on test	214.6	232.3	228.7
Initial weight	387.0	380.3	370.0
Initial score	5.5	5.0	6.0
Days on test	140	140	140
Gain per head			
Total	171.2	167.0	163.3
Average daily gain	1.22	1.19	1.17
Efficiency of feed utilization			
Lbs. TDN/100 lbs. gain	478.2	517.6	551.7
Final weight	558.2	547.3	533.3
Final score	4.8	5.0	4.0

Young Animals on feed

Purebred Date: June 15, 1960

	Hereford		Angus		Shorthorn	
	Number individually fed	Number group fed	Number individually fed	Number group fed	Number individually fed	Number group fed
Bulls		22		6		7
Heifers	11	14	3	4	3	7

Land, Physical Facilities, and Equipment Used Date: June 15, 1960

Item	Number	Actual Cash Value	Percentage Used For Breeding Project
Electro-ejaculator	1 only	$460	90
Corral fence	1 only	$500	70

MONTANA STATE COLLEGE

I. Station: Montana Agricultural Experiment Station, Bozeman, Montana, and the North Montana Branch Station, Havre, Montana

II. Project Title: Recurrent selection and record of performance selection in open and closed beef cattle herds

A. 1. The establishment of inbred lines of registered Hereford cattle, both horned and polled, that will result in improvement in such characters as rate and economy of gain, fertility, nursing ability, longevity, and carcass quality.

2. The maintenance of an outbred herd of Herefords with bulls selected and furnished by the purebred breeders. The bulls primarily are to be good, high-scoring individuals according to breed association standards.

B. 1. The establishment of an improved herd of registered Angus cattle in which the males are selected on a high level of performance as indicated by standard record of performance procedures.

C. 1. The investigation of the feasibility of breeding for specific combining ability through recurrent selection.

III. Personnel:
Montana State College:
Experiment Station:
Bozeman, Montana:
F. S. Willson, Leader, A. E. Flower, Leader, E. P. Orcutt, and J. R. Dynes

North Montana Branch Station, Havre:
J. J. Urick, and Claude Windecker

U. S. Department of Agriculture, Agricultural Research Service:
R. T. Clark, Coordinator

IV. Nature and Extent of Work Done This Year:

Bozeman

In our feed-lot testing of bulls this year we shortened the warmup period from 18 days to 12 days. The Angus bulls showed less weaning stress than did the Hereford bulls. This has happened in three years out of the past four. The Hereford bulls gained 17 pounds during the warmup period and the Angus bulls 24 pounds, as compared to 16 and 36, respectively, last year. The Angus bulls take to the feed a little faster than the Hereford

bulls. We started out with 12 Hereford bulls; one died with bloat during the feeding period. We started with 10 Angus bulls. One went off feed just four days before final weigh day and was not figured in the average.

This is the first crop of calves from the present show type Angus sire that has been indexed. This bull is fully as large as or larger than our ROP bull. The show type Angus bulls outperformed the ROP bulls for the first time by about 0.2 pound per day. The score at the beginning and at the end was a little in favor of the show type bulls both in Hereford and Angus.

The Montana breed associations' committees selecting the bulls for the show type herds have selected bulls of known performance for the past three years and have changed over to a much larger type than had been used previously. It is beginning to show up in the gains of the progeny.

For the past two years, we have been breeding one ROP bull and one show type bull from Bozeman on the Miles City test herd. A year ago, the show type Hereford bull's progeny were at the bottom in gaining ability in the feed lot in comparison with other Hereford lines at the Miles City station. To date this year in the feed-lot test at Miles City the steers from the two ROP bulls whose progeny are being tested are averaging better than the two top lines of Herefords at Miles City. The performance of the lines at the Miles City station is much the same this year as last. This is a good indication that the selection procedure on the ROP line at Bozeman has resulted in improvement and the progeny are doing considerably better than the progeny from the show type bulls.

Bozeman ROP bulls have been top-crossed on a northern Montana rancher's herd. They have been included in the rancher test at the Havre station (see Havre station report). Last year the Bozeman bulls' progeny had nine percent greater gains than did the rancher groups. This year they are running about the same as last year.

At our Red Bluff Research Ranch we continued the comparison of calves from the crossline cows from the Havre herd with cows purchased from good commercial herds. There was a 19-pound weight advantage in the 180-day adjusted weaning weights in favor of calves from crossline cows. Calves in both groups were sired by the same bulls.

The method of determining the 12-month weight was modified from last year's procedure. When animals were on feed at 12 months of age, the weight was estimated by interpolation. When the animal came off feed prior to 12 months of age, the weight was estimated by extrapolation. There were four animals in the latter group.

Havre Station

During the past winter, 88 head of steer calves were fattened on the standard grain and hay ration. Of these, 43 head were station-bred ROP

calves from the recurrent selection breeding project. The remainder were obtained from cooperating commercial cattle ranchers to be used for controls.

The results this year showed no advantage for any of the linecross steer groups over the control Miles City Line 1-bred steers. The linecross steers are the results from mating yearling bulls of Havre Lines I, II, and III on Miles City Line 1-bred grade cows. The steers from the Miles City Line 1 sire this year produced greater gains than did progeny from Miles City Line 1 sires used in previous recurrent selection trials.

The heifer calves were wintered on alfalfa hay as in the past. The linecross heifers from the two polled bulls (Havre Line I) had a 30-pound advantage over the Miles City controls at the final winter weight. The remaining linecross heifers of two horned lines showed no advantage over the controls.

The station ROP linebred and linecross steer groups in this wintering trial showed nearly the same advantage over the rancher outcross steers as during the first year (1958-59). When comparing the same five rancher groups that were fed during the past two winters, the advantage of station steers was 15 percent and 12.5 percent, respectively. The ranchers this year were allowed to select their own steers, and in every case they tended to pick bigger calves than when a gate-cut sample was obtained as during the first year. Last year's results showed a slight advantage in gaining ability of the larger steers over the smaller ones; thus, this year's small increase in gain of the rancher controls would be attributed to the selecting of bigger calves. The rancher cooperator who had the lowest gaining steers last year dropped out of the trial. Had his steers been in the trials this past winter, the advantage of the ROP steers probably would have averaged out very nearly the same as last year.

This year's advantage of the ROP steers over the rancher outcross steers is interesting in view of the fact that many of the cattlemen feel that by visual appraisal they can select better-doing cattle. Results at the station indicate strongly that present day visual appraisal methods can influence gains very little since the selected rancher controls seemed to gain approximately the same as the gate-cut samples that were considered the average of the herd.

The carcass cut-out data this year will furnish additional information for evaluating carcass finality of the various station and rancher groups of steers.

One interesting side light of our research work this past season was the feed-lot performance of one group of steers (rancher group VIII in tables) resulting from a top cross of a Havre Line II bull on a group of rancher outcross cows as compared to the rancher's outcross steers (rancher group

VI in tables). This year's results showed an advantage of 11 percent in favor of the top cross steers. Both groups had the same feeder grade. The past summer, two additional ranchers cooperated in a similar testing program and this year three ranchers are cooperating when five sires from two lines will be tested in a top cross test. The resulting information will be valuable to the station research personnel in evaluating their breeding program, and to the ranchers of this area.

In addition to the steer feeding program, 58 head of heifer calves representing all the station lines and linecrosses, were wintered on full feed of second alfalfa hay. The average gain of all the heifers was 0.80 pound per day for 140 days.

The bull indexing program involved feeding out 15 head of bulls from three lines. They were individually fed for 168 days on a standard grain ration and second alfalfa hay. The individual gains ranged from 2.10 to 2.44 pounds per day, with an average of 2.30 for all bulls.

Means and Adjusted Means of Havre Crossline Fed Yearling Steers and Miles City Test Lines for 1953 and 1959

	1953		1959		% Change
Line	Av. rib eye area sq.in.	Adjusted rib eye area	Av. rib eye area sq.in.	Adjusted rib eye area	based on adjusted area
Havre Line I	(8) 10.22	11.40	(3) 12.01	13.61	+16.2
			(7) 11.44	12.73	+10.4
Havre Line II	(8) 10.03	11.21	(5) 10.91	12.13	+ 7.6
			(7) 11.80	13.02	+13.9
Havre Line III	(7) 10.76	11.91	(5) 12.13	13.46	+11.5
			(6) 11.45	12.79	+ 6.9
Miles City Test Line	(8) 10.77	11.97	(8) 10.85	12.17	+ 1.6

() Number of animals in each progeny group.

The above table shows means and adjusted means for rib eye areas of Havre crossline steers and the Miles City test line for 1953 and 1959. Rib eye areas were adjusted for carcass weight and fat thickness according to the method of Butler (1957)*. The first two years, steer progeny from one sire in each line were tested. From 1955 on, two sire-progeny groups were tested from each line except the Miles City test line. General observations of intervening years were that rib eye area means and adjusted means dropped slightly in 1954 and remained steady until 1956. In 1957 there were slight increases in both means and adjusted means. From 1957 on, there were decided increases in both means and adjusted means for all groups. The table shows, however, that there was a greater percentage of change for all crossline progeny groups than for the Miles City test line.

* Butler, O. P. 1957. The relation of conformation to carcass trials. J. Anim. Sci. 16:227.

V. Summary of Progress - Bozeman

We have increased weaning weights and yearling weights in our ROP lines over the past 12 years.

For the past ten years the Montana Hereford Association has had a committee selecting bulls for our show type herd. The first few years they selected bulls smaller and more compact than the ROP bulls from our closed herd. The ROP progeny usually outgained the others and were heavier at yearling weight. The show type bulls selected for the past four years have been just as large as those in our ROP line. During this period, gains and yearling weights have been switching back and forth.

In 1955, the Montana Angus Association joined in a similar program of selecting bulls of show type to breed part of our cows. The first three years they selected bulls that were 200 to 300 pounds lighter than the bulls used in the ROP herd. The past two years they have selected bulls that were every bit as large as our ROP sires. Until this year our ROP progeny have been heavier at weaning, made greater gains in the feed lot, and are heavier as yearlings. On scores for type, it has been a standoff,--some years one has been a score higher and the next year visa versa. However, this year the show type progeny outgained and outscored our ROP progeny in the Angus breed for the first time.

For our test breeding results, see IV above.

Application of Findings

There is increasing interest on the part of feeders in purchasing feeder calves from high indexed bulls. The Montana Beef Performance Association reports that feeders are paying from 5 to 6 cents per pound premium for certified calves. The commercial men are putting pressure on the purebred breeders, so more of them are trying to qualify now for IPR certificates. The Montana Beef Performance Association reports they will certify around 4,200 commercial calves this fall.

VI. Work Planned for the Future - Bozeman

We are planning at Bozeman to continue about as we have with our selection procedures and our testing of the two lines of Herefords on the Miles City cattle. We also are planning on getting more detailed carcass data.

Havre

More emphasis in the future will be placed on top-crossing station linebred sires on rancher commercial cows. Samples of both the topcross and rancher steers will be fed out at the station. Both feed-lot and carcass data (Including shear test and lean-fat-bone separations) will be obtained from

all steers. This year additional carcass work will be initiated to help evaluate the carcass quality of the steer groups. This will involve taking lean-fat-bone separations of a portion of the prime rib. This work will be done in cooperation with the Meats Laboratory of the Animal Industry Department. Also, a cooking and shear test will be made.

VII. Publications and Manuscripts:

Orcutt, E. P. 1959. Gain-growth record bulls. Performance Register, Sept. 1959:9.

Orcutt, E. P. 1959. Improving Montana beef cattle through breeding on the range. Challenges to Montana Agriculture, Sept.-Oct. 1959:.

Urick, J. J. 1959. Breeding for "nicking" ability. Mont. State Col. Fifth Annu. Beef Prod. Sch. Proc. 5:46-51.

Willson, F. S., and Orcutt, E. P. 1959. Improving Montana beef cattle through breeding at the experiment station. Challenges to Montana Agriculture, 1(1):4.

Windecker, Claude. 1959. How to pick your best cows early. Mont. State Col. Fifth Annu. Beef Prod. Sch. Proc. 5:69-73.

Woodward, R. R., Rice, F. J., Quesenberry, J. R., Hiner, R. L., Clark, R. T., and Willson, F. S. 1959. Relationships between measures of performance, body form, and carcass quality of beef cattle. Mont. Agr. Expt. Sta. B. 550.

Blackmore, D. W., Marchello, J. A., and Urick, J. J. 1960. Differential growth of males and females in different years. Amer. Soc. Anim. Prod. West. Sect. Proc. 11:.

Marchello, J. A. 1960. Heritability of 18-month weight of heifers and the relationship of this weight to the birth and weaning weight of the heifer's first calf. M. S. Thesis.

Marchello, J. A., Blackmore, D. W., and Urick, J. J. 1960. Heritability of 18-month weight of heifers and its relationship to birth weight and weaning weight of their first calf. Amer. Soc. Anim. Prod. West. Sect. Proc. 11:.

Orcutt, E. P. 1960. Personality, pounds, and profit. Western Livestock.

Willson, F. S. 1960. Results proved by research in the beef cattle performance program. Mont. College Farmer 13:.

Table 1.--Bull index (Bozeman) 1958-59 Montana Agricultural Experiment Station

	Calf Eartag (No.)	Cow Eartag (No.)	Cow Age (Yrs.)	Birth Weight (Lbs.)	Age at Weaning (Days)	180-Day Weight (Lbs.)	180-Day Weight Corrected for Age and Age of Dam (Lbs.)	Actual Weaning Weight (Lbs.)	Daily Gain - Preweaning (Lbs.)	Warmup Gain (Lbs.)	Weight on Feed (Lbs.)	Weight Off Feed (Lbs.)	Gain on Feed (Lbs.)	140-Day Average Daily Gain (Lbs.)	12-Month Adjusted Weight (Lbs.)	Yearling Bull Grade*	Gain Index	Sire
Hereford	942	411	8	69	238	389	389	492	1.78	13	505	792	287	2.1	726	79	89	1
	955	811	4	74	228	414	422	506	1.89	4	510	877	367	2.6	836	78	114	1
	960	728	5	83	225	385	385	460	1.68	5	465	822	357	2.6	777	74	111	1
	962	408	8	86	224	397	397	474	1.73	26	500	888	388	2.8	847	77	120	1
	966	826	4	82	188	444	453	460	2.01	11	471	845	374	2.7	821	76	116	1
	972	828	4	90	186	355	362	363	1.47	28	391	733	342	2.4	827	78	106	1
	951	806	4	75	230	424	433	522	1.94	23	545	876	331	2.4	821	81	103	2
	953	803	4	80	229	442	451	541	2.01	26	567	905	338	2.4	852	81	105	2
	956	815	4	91	227	374	382	450	1.63	8	458	811	353	2.5	763	79	110	2
	967	05	2	68	207	361	397	406	1.63	34	440	724	284	2.0	740	73	88	2
	946	155	12	75	234	404	452	504	1.83	13	517	800	283	2.0	757	75	88	2
Angus	924	25	2	67	193	452	497	480	2.14	24	504	896	392	2.8	952	83	125	4
	917	44	13	66	221	383	429	456	1.76	19	475	772	297	2.1	749	76	95	4
	907	20	7	74	229	441	441	541	2.04	24	565	890	325	2.3	841	85	103	4
	922***	8	2	57	195	374	411	400	1.76	23	423	752	329	2.4	811	72	105	3
	920	17	3	65	212	391	412	448	1.81	22	470	822	352	2.5	738	74	112	3
	918	13	7	62	218	413	413	487	1.95	33	520	777	257	1.8	767	73	82	3
	904	5	3	70	231	387	408	480	1.77	40	520	852	332	2.4	803	77	106	3
	903	59	4	70	231	439	447	544	2.05	16	560	860	300	2.1	807	78	96	3
	902	40	13	79	233	473	530	590	2.19	14	604	908	304	2.2	821	81	97	3
	901**	45	12	67	245	479	536	629	2.29	36	665	918	253	1.8	876	81	91	3

* A.H. Form 522, U.S.D.A. ** Off feed from March 10 to March 24. *** 31 percent inbred.

1. ROP Hereford sire - MSC Clay D Suprem 11 8391818.
2. Show type Hereford sire - Royal Heir P 19 624757.
3. ROP Angus sire - MSC Bataans F Restorer 2 1921764.
4. Show type Angus sire - Eliminator 73 of G.M.R. 1609907

Table 2.--Heifers (Bozeman) 1959-60 Montana Agricultural Experiment Station

Calf Eartag (No.)	Cow Eartag (No.)	Cow Age (Yrs.)	Birth Weight (Lbs.)	Corrected Weaning Weight 180-Day (Lbs.)	180-Day Weight Corrected for Age and Age of Dam (Lbs.)	Actual Weaning Weight (Lbs.)	Daily Gain - Preweaning (Lbs.)	Warmup Gain (Lbs.)	Weight On Feed (Lbs.)	Weight Off Feed (Lbs.)	Gain (Lbs.)	140-Day Daily Gain (Lbs.)	12-Month Adjusted Weight (Lbs.)	Score Off Test	Sire
							Hereford								
943	807	5	72	337	337	420	1.47	80	500	687	187	1.3	623	80	2
944	158	13	71	298	334	368	1.26	57	425	616	191	1.4	551	70	2
948	704	6	69	323	323	396	1.41	44	440	696	256	1.8	674	75	2
950	217	11	80	366	410	443	1.59	62	505	751	246	1.8	701	79	2
958	607	7	87	345	345	407	1.41	61	468	705	237	1.7	655	77	2
559	710	6	63	328	328	395	1.47	45	440	658	218	1.6	631	74	2
963	121	15	67	351	393	417	1.58	33	450	625	175	1.2	612	75	2
964	160	13	73	359	402	424	1.59	41	465	633	168	1.2	617	77	2
968	08	3	45	283	298	310	1.32	55	365	515	150	1.1	537	70	2
969	701	6	70	327	327	355	1.43	55	410	594	184	1.3	629	72	2
940	928	4	62	312	318	399	1.39	46	445	644	199	1.4	569	78	1
941	511	8	66	345	345	438	1.55	17	455	677	222	1.6	594	73	1
945	306	10	74	393	393	490	1.77	50	540	659	119	0.8	616	79	1
947	817	5	70	331	331	408	1.45	57	465	675	210	1.5	616	73	1
949	180	12	67	369	413	454	1.68	40	494	700	206	1.5	649	82	1
952	303	10	78	413	413	504	1.82	36	540	737	197	1.4	694	78	1
954	922	4	64	306	312	355	1.74	52	407	615	208	1.5	589	77	1
957	706	6	70	380	380	461	1.72	39	500	692	192	1.4	669	81	1
961	808	5	73	347	347	414	1.52	46	460	676	216	1.5	654	79	1
971.	911	4	68	325	331	349	1.42	49	398	584	186	1.3	630	73	1

1. ROP Hereford sire - MSC Clay D Suprem 11 8991818.
2. Show type Hereford - Royal Heir P 19 624757.

Table 2.--Heifers (Bozeman) 1959-60 (Continued) Montana Agricultural Experiment Station

Calf Eartag (No.)	Cow Eartag (No.)	Cow Age (Yrs.)	Birth Weight (Lbs.)	Corrected Weaning Wt. 180-Day (Lbs.)	180-Day Weight Corrected for Age and Age of Dam (Lbs.)	Actual Weaning Weight (Lbs.)	Daily Gain Preweaning (Lbs.)	Warmup Gain (Lbs.)	Weight On Test (Lbs.)	Weight Off Test (Lbs.)	Gain (Lbs.)	140-Day Daily Gain (Lbs.)	12-Month Adjusted Weight (Lbs.)	Score Off Test	Sire
							Angus								
900	58	5	55	408	408	538	1.96	52	590	785	195	1.4	710	77	3
912	6	4	58	378	385	399	1.78	10	409	623	214	1.5	593	70	3
914	1	7	71	436	436	523	2.03	56	579	855	276	2.0	920	83	3
916	19	9	72	428	428	510	1.98	32	542	750	208	1.5	732	80	3
921	10	4	65	472	481	504	2.26	41	545	760	215	1.5	797	79	3
925	24	3	64	337	355	348	1.52	77	425	598	173	1.2	660	72	3
908	14	7	55	346	346	423	1.58	45	468	706	238	1.7	662	82	4
909	11	10	62	391	391	480	1.83	24	504	752	248	1.8	714	83	4
910	9	6	75	325	325	390	1.39	39	429	692	263	1.9	653	78	4
913	51	5	67	346	346	410	1.55	40	450	709	259	1.8	690	78	4
915	47	7	59	369	369	441	1.72	64	505	740	235	1.7	720	85	4
919	50	14	47	318	356	375	1.51	38	413	605	192	1.4	599	75	4

3. ROP Angus sire - MSC Bataans F Restorer 2 1921764.
4. Show type Angus sire - Eliminator 73 of G.M.R. 1609907.

Cattle Inventory PROJECT SUMMARY Date: June 7, 1960
Purebred Montana Agricultural Experiment Station

Breed	Angus	Angus	Hereford	Hereford
Line	ROP	Show type	ROP	Show type
Station	Bozeman	Bozeman	Bozeman	Bozeman
Bulls (12 mos. or over)	8	6	12 2/	4
Cows (2 yrs. or over)	22	13	29	21
Heifers, yearlings	6	6	10	10
Bull calves	15	6	14 3/	13 5/
Heifer calves	7 1/	4	12 4/	5
Percentage used for breeding project	60	60	60	60
Estimated cash value	$12,100	$7,850	$16,650	$10,650
Grade				
Breed	Hereford			
Station	Red Bluff Ranch			
Cows (2 yrs. or over)	87			
Heifers, yearlings	20			
Steer calves	40			
Heifer calves	46			
Percentage used for breeding project	20			
Estimated cash value	$21,125			

1/ Two crossline heifer calves
2/ Three bulls at Red Bluff Ranch
3/ Three crossline bull calves
4/ Four crossline heifer calves
5/ Four crossline bull calves

Cattle Inventory
Purebred

PROJECT SUMMARY
North Montana Branch Station

Date: June 7, 1960

Breed	Hereford	Hereford	Hereford
Line	Line 1	Line 2	Line 3
Station	Havre	Havre	Havre
Bulls (12 mos. or over)	10	13	10
Cows (2 yrs. or over)	20	35	18
Heifers, yearlings	6	10	3
Bull calves	5	12	5
Heifer calves	11	12	7
Percentage used for breeding project	100	100	100
Estimated cash value	$12,000	$18,000	$10,000
Grade			
Breed	Hereford		
Line	Grade		
Station	Havre		
Bulls (12 mos. or over)	1		
Cows (2 yrs.or over)	120		
Steer calves	42		
Heifer calves	59		
Percentage used for breeding project	100		
Estimated cash value	$46,000		

Montana Agricultural Experiment Station

Cow Production Data (Bozeman)

Breed	Hereford	Hereford
Line	ROP	Show type
Cows bred to calve as 2-yr.-olds	3	5
Calves born from 2-yr.-olds		
Alive	2	4
Dead	0	0
Cows bred to calve at 3 yrs. and up	18	15
Calves born from 3-yr.-olds and up		
Alive	18	14
Dead	0	0
All calves born		
Alive	20	18
Dead	0	0
Total	20	18
Calves weaned	20	18
Percent calf crop*		
Birth	95	90**
Weaning	95	90

	Bulls		Heifers		Bulls		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Average:								
Birth weight	8	78	12	70	7	72	11	70
Weaning age		207		218		212		219
Weaning weight		436		404		431		386
Adj. weaning wt. - 180 days		384		345		372		329
Weaning score:								
Conf.		77		79		79		78

* Based on cows exposed and wintered.

** One culled on basis of pregnancy test.

North Montana Branch Station

Cow Production Data--Purebred — Used Yearling Bull

Breed	Hereford(Polled)	Hereford	Hereford
Line	I	II	III
Cows bred to calve as 2-yr.-olds	5	13	3
Calves born from 2-yr.-olds			
Alive	3	7	1
Dead	1	2	0
Cows bred to calve at 3 yrs. and up	15	24	12
Calves born from 3-yr.-olds and up			
Alive	12	16	7
Dead	1	2	0
All calves born			
Alive	15	23	8
Dead	2	4	0
Total	17	27	8
Calves weaned	17	27	8
Percent calf crop*			
Birth	85	73	53
Weaning	85	73	53

	Bulls		Heifers		Bulls		Heifers		Bulls		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Average:												
Birth weight	9	68	8	63	8	72	19	72	5	77	3	76
Weaning age	188		194		177		176		166		172	
Weaning weight	7	405	7	367	7	394	16	355	5	371	3	390
Adj. weaning wt. - 180 days	390		346		399		361		395		406	
Weaning score Cond.	72		72		76		75		77		76	

* Percent calf crop calculated on basis of $\frac{\text{calves weaned}}{\text{cows in herd previous fall.}}$

North Montana Branch Station

Cow Production Data (Continued) Used Yearling Bulls

Breed	Hereford	Hereford	Hereford
Line	MC Controls	Test Herd	Test Herd
Cows bred to calve as 2-yr.-olds	2	7	6
Calves born from 2-yr.-olds			
Alive	2	6	4
Dead	0	0	0
Cows bred to calve at 3 yrs. and up	27	17	15
Calves born from 3-yr.-olds and up			
Alive	21	10	11
Dead	2	0	1
All calves born			
Alive	23	16	15
Dead	2	0	1
Total	25	16	16
Calves weaned	25	15	16
Percent calf crop*			
Birth	86	67	76
Weaning	86	63	76

	Steers		Heifers		Steers		Heifers		Steers		Heifers	
	No.	Av.	No.	Av	No.	Av.	No.	Av	No.	Av.	No.	Av.
Average:												
Birth weight	10	86	13	76	11	78	5	70	6	76	9	73
Weaning age	172		179		176		179		165		179	
Weaning weight	10	387	13	410	11	392	4	410	9	376	9	398
Adj. weaning wt. - 180 days	398		412		399		412		408		400	
Weaning score Cond.	75		77		75		77		74		75	

* Percent calf crop calculated on basis of calves weaned / cows exposed.

North Montana Branch Station

Cow Production Data (Continued) Used Yearling Bulls

Breed	Hereford	Hereford	Hereford
Line	Test Herd	Test Herd	Test Herd
Cows bred to calve as 2-yr.-olds	6	7	6
Calves born from 2-yr.-olds			
Alive	3	4	3
Dead	1	0	2
Cows bred to calve at 3 yrs. and up	15	16	16
Calves born from 3-yr.-olds and up			
Alive	13	11	8
Dead	0	0	0
All calves born			
Alive	16	15	11
Dead	1	0	2
Total	17	15	13
Calves weaned	16	15	12
Percent calf crop*			
Birth	81	65	59
Weaning	76	65	55

	Steers		Heifers		Steers		Heifers		Steers		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Average:												
Birth weight	6	79	11	71	6	82	9	72	8	73	5	70
Weaning age	185		179		176		176		180		183	
Weaning weight	5	436	11	380	6	397	9	384	6	390	4	398
Adj. weaning wt. - 180 days	424		382		403		391		390		391	
Weaning score Cond.	75		77		76		78		75		79	

* Percent calf crop calculated on basis of $\frac{\text{calves weaned}}{\text{cows exposed}}$.

Montana Agricultural Experiment Station

Cow Production Data (Continued)

Breed	Angus	Angus
Line	ROP	Show type
Cows bred to calve as 2-yr.-olds	5	2
Calves born from 2-yr.-olds		
Alive	3	1
Dead	2	0
Cows bred to calve at 3 yrs. and up	17	10
Calves born from 3-yr.-olds & up		
Alive	12	9
Dead	2	1
All calves born		
Alive	15	10
Dead	4	1
Total	19	11
Calves weaned	15	10
Percent calf crop*		
Birth	86	92**
Weaning	68	83

	Bulls		Heifers		Bulls		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Average:								
Birth weight	7	67	8	63	3	69	7	59
Weaning age		223		208		214		225
Weaning weight		551		447		492		411
Adj. weaning wt. - 180 days		422		391		425		340
Weaning score Conf.		78.8		77.4		81.9		82.3

* Based on cows exposed and wintered.

** One culled on basis of pregnancy test.

North Montana Branch Station

Cow Production Data (Continued)

Breed	2-yr.-old bull Hereford					
Line	Test Herd					
Cows bred to calve as 2-yr.-olds	6					
Calves born from 2-yr.-olds						
Alive	4					
Dead	0					
Cows bred to calve at 3 yrs. and up	17					
Calves born from 3-yr.-olds and up						
Alive	11					
Dead	0					
All calves born						
Alive	15					
Dead	0					
Total	15					
Calves weaned	14					
Percent calf crop*						
Birth	67					
Weaning	67					

	Bulls		Steers		Bulls		Steers		Bulls		Steers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Average:												
Birth weight	9	76	6	62								
Weaning age		178		182								
Weaning weight	9	405	5	348								
Adj. weaning wt. - 180 days		408		345								
Weaning score Cond.		77		74								

* Percent calf crop calculated on basis of $\frac{\text{calves weaned}}{\text{cows exposed}}$

Montana Agricultural Experiment Station

Feed-lot Performance

Breed	H	H	Angus	Angus	H	H	Angus	Angus
Line	ROP	Show type	ROP	Show type	ROP	Show type	ROP	Show type
Sex	Bulls	Bulls	Bulls*	Bulls	Heifers	Heifers	Heifers	Heifers
Number on test	6	5	6	3	10	10	6	6
Average:								
Age on test	219	225	232	225	231	232	221	238
Initial weight	474	505	516	515	470	447	515	461
Initial score Conf.	79	81	78	82	80	78	78	83
Days on test	140	140	140	140	140	140	140	140
Gain per head Total	352	309	312	338	195	201	213	239
Average daily gain	2.5	2.3	2.2	2.4	1.4	1.4	1.5	1.7
Efficiency of feed utilization # TDN/100# gain	669	718	796	741	-	-	-	-
Average:								
Final weight	826	823	829	853	666	648	728	701
Final score Conf.	77	78	76	81	77	75	77	80

* One animal off feed from March 10 to March 24 and was left out of the average as weigh day was March 29.

Montana Agricultural Experiment Station
North Montana Branch Station

Feed-lot Performance — Date: June 7, 1960

Breed	Hereford	Hereford	Hereford	Hereford
Line	Rancher Group I	Rancher Group II	Rancher Group III	Rancher Group IV
Sex	Steers	Steers	Steers	Steers
Number on test	5	6	6	5
Average:				
Age on test	-	-	-	-
Initial weight	439	456	466	434
Initial score	Medium Choice	Medium Choice	Medium Choice	Medium Choice
Days on test	196	196	196	196
Gain per head				
Total	413	429	454	407
Average daily gain	2.11	2.19	2.32	2.08
Final weight	852	885	920	841

Feed-lot Performance (Continued) — Date: June 7, 1960

Breed	Hereford	Hereford	Hereford	Hereford
Line	Rancher Group V	Rancher Group VI	Rancher Group VII	Rancher Group VIII
Sex	Steers	Steers	Steers	Steers
Number on test	6	6	5	6
Average:				
Age on test	-	-	-	-
Initial weight	468	451	406	443
Initial score	Medium Choice	Medium Choice	Medium Choice	Medium Choice
Days on test	196	196	196	196
Gain per head				
Total	450	407	432	451
Average daily gain	2.30	2.08	2.20	2.30
Final weight	918	858	838	894

Montana Agricultural Experiment Station
North Montana Branch Station

Feed-lot Performance (Grade) Date: June 7, 1960

Breed	Hereford	Hereford	Hereford	Hereford
	Controls	Crosslines	Crosslines	Crosslines
Line	MC 637	606 L 1	652 L 1	673 L 2
Sex	Steers	Steers	Steers	Steers
Number on test	7	8	6	4
Average:				
Age on test	-	-	-	-
Initial weight	405	422	371	481
Initial score	Low Choice	Low Choice	Low Choice	Medium Choice
Days on test	196	196	196	196
Gain per head				
Total	487	469	446	491
Average daily gain	2.48	2.39	2.28	2.50
Final weight	892	891	817	971

Feed-lot Performance (Continued) Date: June 7, 1960

Breed	Hereford	Hereford	Hereford	
	Crosslines	Crosslines	Crosslines	
Line	693 L 2	628 L 3	115 L 3	
Sex	Steers	Steers	Steers	
Number on test	6	4	8	
Average:				
Age on test	-	-	-	
Initial weight	390	437	401	
Initial score	Low Choice	Medium Choice	Low Choice	
Days on test	196	196	196	
Gain per head				
Total	451	467	477	
Average daily gain	2.30	2.38	2.43	
Final weight	841	904	878	

Montana Agricultural Experiment Station
and North Montana Branch Station

Young Animals on Feed — Date: June 7, 1960

	Bozeman			
	Hereford		Angus	
	Number individually fed	Number group fed	Number individually fed	Number group fed
Bulls	11		10	
Heifers		20		12
Steers		4		10
	Havre Hereford			
Bulls	14			
Heifers		22		
Steers		2		
Grade				
	Havre Hereford			
Bulls				
Heifers		43		
Steers 1/		96		

1/ Including 43 head of rancher steers.

Land, Physical Facilities, and Equipment Used — Date: June 7, 1960

Item	Number	Bozeman Actual Cash Value	Bozeman Percentage Used for Breeding Project
Beef barn and corrals	1 only	$ 20,000	60
Sheds	5 only	6,800	60
Irrigated land	200 acres	80,000	100
Saddle horses	2 only	300	60
Miscellaneous equipment	-	700	60
Total		$106,000	
	Red Bluff Ranch, Norris, Montana		
Houses	4 only	$ 20,000	10
Old sheds, corrals	3 only	2,000	10
New sheds	3 only	2,000	10
Deeded grazing land	9,906 A. ($12.75)	124,153	10
Irrigated land	273 A. ($70.00)	19,110	10
Saddle horses	1 only	150	10
Total		$168,013	

Montana Agricultural Experiment Station
North Montana Branch Station

Land, Physical Facilities, and Equipment Used (Continued) June 7, 1960

Item	Number	Actual Cash Value	Percentage Used for Breeding Project
Bull barn	1 only	$17,500	75
Long shed	1 only	17,500	90
Home pasture	1,780 acres	28,700	90
Home farm land	200 acres	6,000	85
Leased pasture	5,000 acres	55,000	100
A. I. truck	1 only	1,700	75
Saddle horses	8 only	800	90
Scale and weigh house (station)	1 only	1,900	90
Scale and weigh house (lease)	1 only	700	100
Corrals at home station	-	3,000	90
Corrals at lease	-	1,500	100
Cattle squeeze	2 only	400	100
Cabins at lease	2 only	2,000	100
Automatic waterers	5 only	500	90

UNIVERSITY OF NEVADA

I. Station: Nevada Agricultural Experiment Station, Reno, Nevada

II. Project Title: The effect of genetic-environmental interactions on selection responses

III. Personnel:

Experiment Station:

D. W. Cassard, leader, J. F. Kidwell, H. J. Weeth, L. Haverland, and assistants

U. S. Department of Agriculture:

R. T. Clark, Coordinator

IV. Nature and Extent of Work Done This Year:

1. Tribolium: Data from an investigation of temperature, sire, dam, and genotype-environment interaction effects on reproduction in Tribolium have been analyzed partially but results are not available as yet.

2. Rats: A 2 x 2 factorial experiment was used to estimate the effect of two selection procedures (mass selection for 70-day body weight, and random selection), two nutritional regimes (high and low "bulk"), and the interaction between them on the body dimensions and relative organ size in the laboratory rat. A total of 220 individuals from 38 litters distributed between the two sexes provided the data. Observations included 70-day weight, body length and width, weight of unwashed gastrointestinal tract, washed stomach, caecum and colon, small intestine, liver, heart, and thyroid, and the ratio of each to body weight. There was evidence of genetic and environmental destabilization for some but not all of the traits. There also was evidence of genetic-environmental interaction, but it was more frequent among the females. Selection had an effect on over-all body proportions while ration influenced the relative size of the digestive tract.

An experiment designed for comparison of switched vs. regular rations, and other comparisons, for effects on 70-day weight was imposed on first and second litters in both the seventh and eighth generations. The data are complete but have not been analyzed.

Six littermate pairs of males, 70 days of age, from each of the eight line-ration groups in generation seven were used in digestion trials. Pairs were selected as metabolism cage space became available and as the rats attained 70 days of age. Feed consumption supplied ad libitum was observed over seven days, and feces were collected over the last five days. Urine was not collected. Standard analyses were used for ether

extract, crude fiber, crude protein, ash, and nitrogen-free extract components of feed and feces. Energy content was determined with a Parr adiabatic bomb colorimeter.

Select rats were superior for weight at 70 days of age, relative growth during the digestion trials when on regular rations but not on switched rations, feed capacity, and efficiency of feed utilization when on regular rations but not on switched rations. Significant differences in general adaptation response between rats of the roughage lines and rats of the standard lines were evident for 70-day weight and feed capacity, with roughage lines having the greater averages.

Computation of inbreeding coefficients, relative to the four-way cross progeny of the base population, has been completed through generation six. Fertility of the lines appears to be correlated with the average inbreeding of the line, but this relationship has not been studied in detail. Means and ranges of the coefficients for the lines in generation six were:

Line	Mean	Range
Standard select	.14	.07 - .18
Standard random	.07	.05 - .13
Roughage select	.10	.03 - .11
Roughage random	.07	.05 - .11

V. Summary of Progress and Conclusions to Date:

Data sufficient for partial evaluation of differences due to selection and adaptation in rats have been gathered and partly analyzed.

Application of Findings

While the results from the digestion trials are suggestive in regard to breeding plans, further evaluation of differences is necessary for interpretation and application of project results.

VI. Work Planned for the Future:

Reproductive difficulties have been encountered, particularly in the standard select line. It is hoped that pedigree studies will help in understanding and eliminating the problem.

Activity studies proposed for last year could not be completed with adequate experimental designs, because of time and equipment limitations, and were not initiated. Studies of voluntary activity coupled with tracer studies of thyroid metabolism are planned.

Digestion trial studies with restricted intake are particularly desirable for interpretation of differences between the lines in efficiency of feed utilization. Growth curve studies would help to interpret body weight and gain responses.

VII. Publications and Manuscripts:

Kidwell, J. F., V. R. Bohman, M. A. Wade, L. H. Haverland, and J. E. Hunter
1959. Evidence of genetic control of blood potassium concentration in sheep. J. Hered. 50:275-278.

Kidwell, J. F., H. J. Weeth, W. R. Harvey, L. H. Haverland, C. E. Shelby, and R. T. Clark.
1960. Heterosis in crosses of inbred lines of rats. Genet. 45:225-231.

Kidwell, J. F., H. J. Weeth, L. H. Haverland, C. E. Shelby, and R. T. Clark
1960. The effect of selection and plane of nutrition on relative size in the rat. Growth 24:47-58.

Kidwell, J. F., H. J. Weeth, L. H. Haverland, C. E. Shelby, and R. T. Clark
The effect of selection and plane of nutrition on repeatability of litter size and weight in the laboratory rat. (Being reviewed for publication in J. Hered.)

Haverland, L. H., J. F. Kidwell, V. R. Bohman, H. J. Weeth, and R. T. Clark. The effects of selection and nutritional environment on digestibility and efficiency in rats. (Manuscript prepared.)

I. Station: Nevada Agricultural Experiment Station, Reno, Nevada

II. Project Title: The effect of environment on selection of traits of economic importance; the value of several selection criteria; and reproductive studies in range beef cattle

III. Personnel:

Experiment Station:

D. W. Cassard, leader, W. D. Foote, J. Hunter, C. Torell, permanent and temporary farm labor and student assistants

U. S. Department of Agriculture:

R. T. Clark, Coordinator

IV. Nature and Extent of Work Done This Year:

Maintenance of the lines has continued and data from feeding trials, etc., have been collected according to plan. Some analyses comparing rate of gain of progeny in the rate and economy lines at the different stations have been made.

Table 1.--Analyses of rate of gain in the rate and economy lines at the Reno and Knoll Creek stations

	1956-57		1956-57		1956-57		1956-57	
	M	F	M	F	M	F	M	F
Number of animals	30	37	55	31	41	49	46	35
Selection	NS	NS	-	NS	NS	-	-	NS
Station	**	**	-	NS	**	-	-	**
Interaction	NS	NS	**	$<.1$	NS	*	**	NS

* Significant at 5 percent level

** Significant at 1 percent level

With the exception of heifers in 1957-58, station effects and interaction effects have been significant in all years. The station effects are expected since the Reno lines receive grain as well as hay and their rate of gain has exceeded that of the Knoll Creek lines except for the year 1957-58. The appearance of interaction effects is surprising. Only in the last year were the progeny from selected bulls.

Statistical evaluations of line difference within stations over years have not been completed. Perusal of rate of gain means indicates marked year differences not attributable to selection.

Phenotypic correlations calculated within line and sex over years are presented in Table 2. There is a very strong association between rate and economy of gain. This correlation is greater in the "good" environment, but any interpretation of this must await subdivision into environment and genetic components. There is a tendency for phenotypic correlation between rate of gain and weaning weight to be negative, indicating that selection for rate of gain may result in simultaneous selection for poor maternal ability. The same is indicated by the economy of gain-weaning weight correlation.

Table 2.--Phenotypic correlations calculated within line and sex over years

	R I		R II		R III		K I		K II	
	M	F	M	F	M	F	M	F	M	F
Rate of gain-weaning weight	.11	-.19	-.04	-.52**	.04	.01	-.24	-.04	-.11	-.13
Economy of gain-weaning weight	.18	.30	.22	.64**	.17	.20	.48**	.21	.56**	.56**
Rate of gain-Economy of gain	-.89**	-.90**	-.89**	-.92**	-.92**	-.92**	-.84**	-.82**	-.80**	-.79**

* Significantly different from zero at 5 percent level
** Significantly different from zero at 1 percent level

V. Summary of Progress and Conclusions to Date:

Progress has been according to plan, and a beginning has been made in evaluating project results.

Application of Findings

Summarization of data has not been completed sufficiently for application.

VI. Work Planned for the Future:

There is little to be added to last year's statement. A new animal geneticist will be employed by the station, and the project will proceed with continuity in the future.

VII. Publications and Manuscripts:

Kidwell, J. F., J. E. Hunter, P. R. Ternan, J. M. Harper, C. E. Shelby, and R. T. Clark
1959. Relation of production factors to conformation scores, body measurements, associations among production factors, and the relation of carcass grade and fatness to consumer preference in yearling steers. J. of Anim. Sci. 18:894-908.

Kidwell, J. F., P. R. Ternan, J. E. Hunter, J. M. Harper, C. E. Shelby, and R. T. Clark
1959. Relations among conformation scores, body measurements, and production factors of yearling steers. Nev. Agr. Expt. Sta. Tech. B. 204.

Ternan, P. R., J. F. Kidwell, J. E. Hunter, C. E. Shelby, and R. T. Clark
1959. Associations among conformation scores, among body measurements, and the relations between scores and measurements in yearling steers. J. Anim. Sci. 18:880-893.

Cattle Inventory — PROJECT SUMMARY
Purebred — Nevada Agricultural Experiment Station — Date: 6-1-60

Breed	Hereford	Hereford	Hereford	Hereford	Hereford
Line Station	RI Rate of Gain Reno	R II Economy of Gain Reno	R III Conformation Reno	K I Rate of Gain Knoll Cr.	K II Economy of Gain Knoll Cr.
Bulls (12 mos. or over)	4	4	4	4	4
Cows (2 yrs. or over)	30	30	30	31	36
Heifers, yearlings	4	5	6	4	4
Bull calves	10	17	8	6	10
Heifer calves	13	10	16	8	17
Percentage used for breeding project	100	100	100	100	100
Estimated cash value	$12,200	$13,200	$12,800	$12,200	$11,600

Cow Production Data — Date: 6-1-60

Breed	Hereford	Hereford	Hereford	Hereford	Hereford
Line	R I	R II	R III	KI	KII
Cows bred	27	34	27	25	30
Calves born					
Alive	15	29	22	19 1/	27 2/
Dead	1	0	1	0	0
Total	16	29	23	19	27
Calves weaned	15	29	22	19	25
Percent calf crop*					
Birth	59	85	85	76	90
Weaning	56	85	81	76	83

* Calves born alive or weaned / Cows exposed to bull

1/ Three misbred calves

2/ Five misbred calves

Feed-lot Performance Nevada Agricultural Experiment Station Date: 6-1-60

Breed	H	H	H	H	H	H	H	H	H	H
Line	RI	RI	RII	RII	RIII	RIII	KI	KI	KII	KII
Sex	B	H	B	H	B	H	B	H	B	H
Number on test	6	8	18	11	11	11	9	7	13	9
Average:										
Age on test	240	240	240	240	240	240	240	240	240	240
Initial wt.	544	453	525	490	525	487	406	355	411	370
Initial score Conf. (8mos.)	83.7	82.8	83.8	84.6	83.9	84.5				
Days on test	140	140	140	140	140	140	140	140	140	140
Gain per head										
Total	314	176	276	179	266	157	131.4	118.3	142.5	117.5
Average	2.24	1.26	1.97	1.28	1.90	1.12	.94	.84	1.02	.84
Efficiency	12.91[a]	17.29[a]	14.54[a]	17.36[a]	14.79[a]	19.39[a]	10.40[b]	10.57[b]	10.30[b]	11.08[b]
Final weight	858	629	801	669	791	644	537.5	472.9	554.0	487.2
Final score Conf. (13 mos.)	83.7	82.5	82.8	83.0	82.5	84.3	82.1	83.4	82.5	83.3

[a] $\frac{2 \text{ (lbs. hay)} + \text{lbs. grain}}{\text{lbs. gain}}$

[b] $\frac{\text{lbs. hay}}{\text{lbs. gain}}$

Young Animals on Feed Date: 6-1-60

	Number individually fed	Number group fed
Bulls	57	0
Heifers	46	0
Steers	0	0

Land, Physical Facilities, and Equipment Used Date: 6-1-60

Item	Number	Actual Cash Value	Percentage Used for Breeding Project
Reno station: Land, buildings, etc.	1 only	$350,000	20
Knoll Creek station: Land, buildings, etc.	1 only	100,000	60
Laboratories	1 only	100,000	30

NEW MEXICO STATE UNIVERSITY

I. Station: New Mexico Agricultural Experiment Station, University Park, New Mexico

II. Project Title: Breeding beef cattle for southwestern ranges

III. Personnel:

Experiment Station:
L. A. Holland, J. H. Knox, and D. W. Zinn

U. S. Department of Agriculture, Agricultural Research Service:
R. T. Clark, Coordinator

IV. and V. Nature and Extent of Work Done This Year, and Summary of Progress and Conclusions to Date:

Genetic studies of carcass characteristics of beef cattle continued satisfactorily. Steers born in the grade herd are brought into feed lots following weaning, fed for approximately 7-1/2 months, and slaughtered at 15-16 months of age. Most of them grade average to high good. Before slaughter the steers are measured and scored. Carcasses are measured and scored before being broken into wholesale cuts. Wholesale cuts are weighed and scored for conformation, quality, thickness of lean, thickness of fat, uniformity of finish, amount of marbling, and grade.

Data were obtained on 30 steers in 1958, 31 steers in 1959, and will be obtained on 32 steers in 1960. Heritability analyses within each of the years 1958 and 1959 have been almost completed. Some of the estimates from the 1959 data are:

	Heritability
Live animal	
Conformation	1.07
Quality	.61
Grade	.26
Weight	.57
Carcass	
Conformation	.92
Quality	.24
Grade	.72
Thickness of lean	.00
Thickness of fat	.93
Uniformity of finish	.88
Amount of marbling	.65
Rib eye area	1.04
Shear test values	.13

An analysis of vaginal prolapse data was begun. The striking feature of these data is that prolapse does not occur in the range herd, but does occur in the purebred herd maintained under farm conditions. Bulls used in the range herd since 1935 have been produced in the purebred herd. Most of the bulls used in the purebred herd also served in the range herd. The number of purebred cows that had produced at least one calf before leaving the herd is:

Primary Reason for Disposal	Number
Cancer eye	12
Death	15
Prolapse	19
Other	78
Total	124

More than 19 had prolapse but it was not severe enough to cause shipment. Inheritance within the purebred herd will be studied.

Using New Mexico data, Dr. R. L. Blackwell completed an analysis of heritabilities of, and genetic and environmental correlations between, weaning weight, weaning grade, yearling weight, yearling gain, yearling grade, final weight, daily gain, slaughter grade, carcass weight, dressing percent, and carcass grade. The paper should be submitted soon for publication. Because the charts are quite lengthy and should be accompanied by discussion, results are not reported herein.

Application of Findings

Beef cattle producers evinced considerable interest in meats research at the Cattle Breeders' School held on the campus in February 1960.

VI. Work Planned for the Future:

The individual bull feeding data will be analyzed.

Live animal, slaughter, and carcass data will be obtained from 32 feed-lot steers. Carcass data in addition to that outlined in the project plan will be obtained as follows:

The full carcass will be broken down into wholesale cuts and weights will be recorded. These cuts will then receive a "retail trim" as outlined by King in Proceedings of Reciprocal Meats Conference, 1959. The trimmings will be separated into fat, lean, and bone, and the weights of retail cuts and trim will be recorded. These cuts will be broken into retail cuts (steaks, roasts, etc.) and, if necessary, additional trimming will be made. The weights of all retail cuts and all trim will be recorded.

VII. Publications and Manuscripts:

Blackwell, R. L., J. H. Knox, and Estel Cobb. 1959. A hydrocephalic lethal in Hereford cattle. J. Hered. 50:143-148.

Knox, John H. 1959. Beef cattle performance test. Performance Register, Jan.1959:10.

Knox, J. H., and W. E. Watkins. 1959. Range trials prove practice pays most years. West. Livestock 44(9):44-45.

Knox, John H. 1960. National organization can contribute to improving productivity of beef cattle. Beef Performance Register April 1960:9.

Zinn, D. W. 1960. Beef carcass research at New Mexico State University. N. Mex. State Univ. Fifth Annu. Cattle Breeders' Sch. Mimeog. Rpt.

Zinn, D. W., and F. G. Heckman. 1960. How carcass research data are obtained. N. Mex. State Univ. Fifth Annu. Cattle Breeders' Sch. Mimeog. Rpt.

Cattle Inventory PROJECT SUMMARY
Purebred New Mexico Agricultural Experiment Station Date: 6-16-60

Breed	Hereford	Hereford
Line	Old Line	Outcross
Station	Main	Main
Bulls (12 mos. or over)	6	3
Cows (2 yrs. or over)	33	16
Heifers, yearlings	12	6
Bull calves	14	5
Heifer calves	11	5
Percentage used for breeding project	80	80
Estimated cash value	$23,600	$11,100

Grade

Breed	Hereford
Line	Grade
Station	Main
Bulls (12 mos. or over)	5
Cows (2 yrs. or over)	117
Steer calves	42
Heifer calves	41
Percentage used for breeding project	50
Estimated cash value	$36,540
Heifer yearlings	32

New Mexico Agricultural Experiment Station

Cow Production Data

Date: June 15, 1960

Breed	Hereford	Hereford
Line	Old	Outcross
Cows bred to calve as 2-yr.-olds	4	0
Calves born from 2-yr.-olds		
Alive	3	0
Dead	0	0
Cows bred to calve at 3 yrs. and up	22	18
Calves born from 3-yr.-olds and up		
Alive	16	14
Dead	3 (aborted)	3 (1 set twins)
All calves born		
Alive	19	14
Dead	3	3
Total	22	17
Calves weaned	17	14
Percent calf crop		
Birth*	85	89
Weaning*	65	78

	Bulls		Steers		Heifers		Bulls		Steers		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Average:												
Birth Weight	5	85	1	52	11	76	1	79	4	71	7	70
Weaning age		246		267		245		242		247		246
Weaning weight	6	530	1	430	10	489	1	490	5	455	8	432
Adj. weaning wt. - 180 days		-		-		-		-		-		-
Weaning score												
Cond.**	6	8.3	1	5.0	10	10.5	1	10.0	5	9.2	8	8.6
Conf.**	6	6.8	1	5.0	10	6.7	1	7.0	5	6.2	8	6.5

(Wean at approximately eight months)

* Method used in calculation:

Percent calf crop birth = Number of cows calving (live and dead calves) relative to number of cows exposed

Percent calf crop weaning = Number of calves weaned relative to number of cows exposed

** Larger numerical scores more desirable

New Mexico Agricultural Experiment Station

Cow Production Data Date: June 15, 1960

Breed	Hereford			
Line	Grade			
Cows bred to calve as 2-yr.-olds				
Alive	0			
Dead	0			
Cows bred to calve at 3 yrs. and up	128			
Calves born from 3-yr.-olds and up				
Alive	111*			
Dead	1(hydrocephalic)			
All calves born				
Alive	111*			
Dead	1			
Total	112*			
Calves weaned	90*			
Percent calf crop				
Birth	89*			
Weaning	*			
	Steers		Heifers	
	No.	Av.	No.	Av.
Average :				
Birth weight	--	--	--	--
Weaning age	210		208	
Weaning weight	43	402	46	362
Adj. weaning wt. - 205 days**	410		374	
Weaning score				
Cond.	--	--	--	--
Conf.***	--	6.7	--	6.5

*Some cows assumed pregnant were shipped in spring 1959. These were counted as having borne live calves when figuring percent calf crop at birth. Of the 97 calves born alive, 2 were killed by coyotes and 6 died of unknown causes. No good basis for figuring percent calf crop at weaning.

**Also adjusted for age of dam.

***Based on a scale from one through nine, nine being highest score.

New Mexico Agricultural Experiment Station

Feed-lot Performance Date: Completed test during calendar year 1959

Breed	Hereford	Hereford
Line	Old	Outcross
Sex	Bulls	Bulls
Number on test	3	5
Average: Age on test	10-1/2 mos.	10-1/2 mos.
Initial weight	630	639
Initial score		
Cond.	--	--
Conf.	--	--
Days on test	136	129
Gain		
Total	324	301
Average	2.37	2.34
Efficiency of feed utilization		
Lbs. TDN/100 lbs. gain	441	463
or		
Lbs. gain/100 lbs. TDN	--	--
Final weight	954	940
Final score		
Cond.	--	--
Conf.	--	--

New Mexico Agricultural Experiment Station

Young Animals on Feed Date: June 15, 1960

Purebred

Hereford	Hereford
Number individually fed	Number group fed
Bulls 13	-
Heifers -	18
Steers -	8

Grade

Hereford	Hereford
Number individually fed	Number group fed
-	-
-	-
-	40

Land, Physical Facilities, and Equipment Used

Item	Number	Actual Cash Value	Percentage Used for Breeding Project
Range land	63,000 acres	$189,000	33
Farm land	52 acres	52,000	33
Feed lots	-	30,000	50
Barns	2 only	120,000	70
Meat laboratory	1 only	100,000	10
Pathology laboratory	1 only	40,000	15
Calculators	4 only	2,800	60
Office equipment	-	600	60

OREGON STATE COLLEGE

I. Station: Oregon Agricultural Experiment Station, Corvallis, Oregon

II. Project Title: Improvement of beef cattle through breeding methods using basic physiological differences in rate and efficiency of gains

III. Personnel:

Oregon State College:

Experiment Station:

Central Station, Corvallis:

Ralph Bogart, Leader, Hugo Krueger, G. I. Alexander, Robert C. deBaca, Walter Kennick, Tim Bhannasiri, Franklin Ampy, Noah England, D. C. Church, and James Kidwell

Squaw Butte-Harney Range and Livestock Station, Burns:

W. A. Sawyer, and Joe Wallace

Eastern Oregon Branch Station, Union:

James McArthur

Malheur Branch Station, Ontario:

E. N. Hoffman

John Jacob Astor Branch Station, Astoria:

H. B. Howell

Statistics Department:

L. D. Calvin and R. G. Peterson

U. S. Department of Agriculture, Agricultural Research Service:

R. T. Clark, Coordinator

IV. Nature and Extent of Work Done This Year:

Objectives:

1. The growth pattern of calves differing in rate and efficiency of gains, and according to sex, line, and year

2. The relation of nitrogenous and carbohydrate constituents of the blood and urine to rate and efficiency of gains

3. The relation of blood enzymes to rate and efficiency of gains

4. Selection for greater rate and efficiency of gains on a ration composed primarily of roughage

5. The development and use of inbred lines

6. Testing bulls of the inbred lines on commercial cows to determine their value as sires of good-doing calves

7. The inheritance of the tendency for chronic bloating

8. The interaction of inheritance and nutrition (or other environmental factors) in causing abnormalities

9. The use of physiological studies in establishing or assisting in development of reliable indices for beef cattle improvement

10. Influence of inbreeding on performance traits

11. Determine relationship between certain physiological factors and carcass value

V. Summary of Progress and Conclusions to Date:

1. The relative effects of selection and inbreeding of calf and of dam were studied using 280 calves from four inbred lines of Hereford and Angus cattle. No effect of inbreeding of calf was found on birth weight and rate and economy of gains during performance test. No reason could be advanced for the lack of influence of inbreeding on birth weight. The failures of inbreeding to depress feed test criteria were considered to be due to the compensation of selection for the expected inbreeding depression. Significant effects due to inbreeding were found for suckling gains, age at 500 pounds body weight, and age at 800 pounds body weight. There was a significant positive association between inbreeding of dam and rate of gain, indicating the effectiveness of selection for rate of gain.

2. The growth and feed efficiency pattern of the calves has been analyzed using data covering six years of research in which weekly weights were obtained from birth to 800 pounds body weight, and weekly feed efficiencies were obtained from 500 to 800 pounds body weight. This analysis was done in cooperation with J. F. Kidwell and C. E. Shelby of the Regional office. The growth data were analyzed for the nursing period, for the feed-test period, and from birth to 800 pounds body weight. Analysis included the determination of how the growth curves fit first-, second-, third-, fourth-, and fifth-degree polynomials. All the curves were linear, but approximately three-fourths of the animals also had growth curves that fit second-, second- and third-, and second-, third-, and fifth-degree polynomials. There were very few growth curves in the first and second, first and third, first and fourth, or first and fifth. Likewise, there were few in the first along with second and fourth; second and fifth; third and fourth; third and fifth; fourth and fifth; second, third, and fourth; second, fourth, and fifth; or third, fourth and fifth. A greater percentage of bulls than heifers showed linear growth only.

3. Blood and serum albumen and alpha, beta, and gamma globulin have been determined on the 1958 calves at each 100-pound increment from 500 to 800 pounds body weight, inclusive, on the 1959 calves at birth and at each 100-pound increment from 500 to 800 pounds body weight, and is being determined on the 1960 calves at each 100-pound increment from birth to 800-pounds body weight. In addition, total blood serum protein content and urea nitrogen are being determined on the 1960 calves at each 100-pound increment in body weight from birth to 800 pounds body weight.

4. Data were obtained and analyzed for serum acid and alkaline phosphatases and serum inorganic phosphate of suckling calves, calves during feed test, and adult cows. A manuscript summarizing all the work on this study was prepared for a technical bulletin but its publication has not met with approval.

5. A bloater bull was mated to eight bloater or closely related cows to obtain more information on the inheritance of the tendency to bloat. Studies have been initiated on the saliva from bloater and normal animals.

6. The heritability of rate of gain and feed efficiency is being determined at the Squaw Butte station by individually feeding calves produced by dams that had been feed-tested, half of them on a high level of feeding and the other half on a ration composed largely of roughage. This study is nearing completion.

7. Changes in hemoglobin and blood cellular constituents associated with increases in body weight of calves have been determined and analyzed.

The amount of hemoglobin per unit volume of the blood, hemoglobin content of individual red blood cells, and the concentration of hemoglobin in each red blood cell increased with increases in body size from 500 to 800 pounds body weight of beef calves (Hereford and Angus). The number of red blood cells decreased with increased body weight. Increases in hemoglobin with decreases in size and number of red blood cells require physiological adjustments.

The number of white blood cells, lymphocytes and monocytes decreased with increases in body weight while the number of neutrophils, eosinophils and basophils were variable from weight to weight. The most logical explanation for these changes is the response to more uniform conditions provided the calves during the feed test which largely relieved stress effects.

8. Female mice from six strains were injected intramuscularly with one mg. testosterone (Oreton) per kg. body weight, or with 0.91 percent $NaCl$ per week. Testosterone or saline was administered every third day beginning at 21 days of age and continuing for either 14 or 21 days. At 45 days of age the females were bred to males from each of their respective strains. The response of the female mice to testosterone was measured by studying number of females bred that littered, number of young born, and survival of young up to 12 days of age.

There did not appear to be any evidence for a harmful effect from previous treatment with testosterone on number of young born or on survival of young. There was a slight, though not significant, decrease in percentage of females that littered in the testosterone-treated groups. Evidence from number of young born per litter indicated that some strains responded favorably while others responded unfavorably to testosterone.

9. The three lines of Herefords and one of Angus at the Central Station are being continued as closed lines.

The feed-test performance has been the worst in the history of the studies at Oregon State College. Also, the feed provided was the lowest in quality that ever has been fed. Low quality materials were used in composing the pelleted ration and much of the feed has become badly molded in the storage bin, almost to the point of rotting, with the result that feed intake is approximately 70 percent of that in past years. Rates of gain and feed efficiencies also are about 65 percent of those obtained in the past.

The Lionheart and Angus lines have good calf crops on the ground and they are showing good vigor. Half of the cows in the David line were bred artificially using frozen semen from which very poor settling was obtained. Calving percentage by the other bull used in this line is normal and calves in this line are average in vigor.

Several years ago several cases of hydrocephalus and enlarged thyroid glands occurred with incidences in the Prince, David, and Angus lines. Because of the enlarged thyroid glands it was deemed advisable to give all cattle iodized salt. During the past winter noniodized salt was used. One bull in the Prince line has sired eight calves of which six were hydrocephalic and one abnormal (small and listless). It appears that there is a genetic-nutrition interaction involved since it has occurred in this line only and in such high frequency from one sire this year. Very few cows were settled by the other bull used in this line or fetal resorption occurred if the cows did become pregnant. They did not appear to be returning to heat during the 65-day breeding season.

10. Bulls from each of the three Hereford lines at Corvallis and the line at Union are being tested on commercial cows by using one bull from each of the four lines each year on commercial cows at the Union station. The second crop of calves are now under evaluation tests. Bulls by each of the four sires (about three from each) are being feed-tested. Steers by each of the four sires are being fed in lots. Gains and carcass evaluations have been obtained on the steers from the previous crop. Gains and feed efficiency determinations were made on the bulls. The heifers will be kept in the herd for evaluation of their abilities in calf production. Also, bulls from the Prince and David lines are used on commercial cows at the Astoria station.

The rate of gain during a feeding period of 152 days was recorded on six heifers sired by a Prince bull (F 33) and ten heifers sired by a David bull (F 52) at the Astoria station. The average daily gain of heifers sired by the Prince bull was 1.70 pounds and for those sired by the David bull, 1.83 pounds per day.

At the Union station, bulls sired by bulls of the four lines of Herefords (Lionheart, Prince, David, and Union) have been individually fed, and their records are presented below.

Line of Sire	Number of Bulls	Suckling Gains (Lbs.)	Feed Test Gains (Lbs.)	Feed Per 100 Lbs. Gain (Lbs.)
Lionheart	3	1.54	1.98	590
Prince	2	1.90	2.47	603
David	2	1.28	2.73	519
Union	2	1.49	2.22	596

Carcasses of steers sired by bulls of the four lines of Herefords (Lionheart, Prince, David, and Union) were appraised by scoring for finish, conformation and marbling of the carcasses and by tracings of loin eye and prediction of lean content from a carcass probe. The data on scores are presented below.

Line of Sire	Number of Steers	Dressed Wt. of Steer Carcasses (Lbs.)	U.S.D.A. Grade	Conformation Score	Marbling Score
Lionheart	6	525	High Good	Low Choice	Small
Prince	2	551	High Good	Choice	Small
David	6	580	High Good	Low Choice	Modest
Union	12	567	Av. Good	Low Choice	Slight

The gains on feed test, feed efficiency, dressed weight, and scores for finish and marbling are all in favor of calves sired by the David line bulls. However, these calves were lowest in suckling gains. The Lionheart calves were superior to all others in conformation score but inferior to all others in gains on test. The Union-sired calves were lowest in finish score and in marbling.

11. A study was conducted on 417 heifers and 390 steers which were progeny of 250 dams and 165 granddams. The calves were born and raised in the years 1947 through 1956 on the Squaw Butte-Harney Experiment Station at Burns, Oregon.

Least squares analyses were employed to study the extent of genetic, environmental, and residual maternal influences on growth from birth through long-yearling age. The growth traits studied were birth weight, weaning weight adjusted to 225 days, yearling weight adjusted to 385 days, long-yearling weight adjusted to 505 days, and all possible combinations of

gains obtained by differences. Environmental effects considered in the analyses were: years, age of dam, whether a cow raised or did not raise a calf in the previous year, age of dam at first calving, season of birth, plane of winter nutrition, and age of granddam. Separate analyses of environmental effects were conducted for heifers and steers. The data for seven traits were adjusted for the environmental effects and the sexes were combined by an appropriate multiplicative adjustment.

a. Estimates of repeatability of cow productivity were calculated for seven of the ten growth traits. The estimates were: birth weight, .15; weaning weight, .33; yearling weight, .31; long-yearling weight, .16; suckling gain, .34; yearling gain, .23; and long-yearling gain, .16.

b. There are some indications in the steer analyses of permanent environmental influences due to age of granddam; however, no pattern of influence was established. It was ultimately concluded that the methods employed did not identify influences which can be definitely attributed to permanent residual maternal sources.

c. Animals which in one period endure a restriction in growth due to one or more of many environmental influences (age of dam, season of birth, etc.) tend to compensate for the restrictions in the next period. The compensations for the various influences are shown to be measurably independent, and are directly related to the extent of deprivation in the initial phase. Furthermore, the compensations are offset in subsequent phases through a reversed compensation. Compensations in later phases are less complete than the initial compensations.

d. The discrepancies among repeatability estimates for the various traits are attributed to differences in the environments to which animals were subjected in various growth phases rather than to changes in genetic potential. Changes in growth rates due to compensatory growth relationships result in the lower repeatability estimates for long-yearling weight and gains.

e. Selections of calves with heavy weaning weights should lead to improvement in subsequent growth rates. Selections based on gains in given phases of post-weaning growth would contain inaccuracies due to compensatory growth.

f. Differences were noted between all growth traits of heifers and steers. Steers exceeded heifers in the various traits by the following amounts: birth weight, 6.28 percent, weaning weight, 5.16 percent; yearling weight, 3.73 percent; long-yearling weight, 3.83 percent; suckling gain, 4.74 percent; yearling gain, 3.25 percent; and long-yearling gain, 3.51 percent. The coefficients of variation were similar for animals of the two sexes. Adjustment of heifer data to a steer equivalent was accomplished in each trait by multiplicative correction to the extent of the difference between the sexes.

g. Effects of years were measured by the express method of adjusting the data to a constant-year basis. Improved management practices which have been initiated on the experimental range are being reflected in greater gains and weights in all growth phases.

h. Age-of-dam influences were apparent in all pre- and post-weaning growth phases. Two-year-old cows were unable to provide their calves with either pre- or post-natal environment approximating that of mature cows. This deprivation is still measurable in long-yearling weights. Birth weights of calves from cows of all ages except two-year-olds were similar. Cow productivity reflected in suckling gains of calves increased with increased age up to four years, then maintained a plateau through eight years of age. After nine years of age there was a decline in productivity which was more marked in steer offspring than in heifers. Approximate additive correction factors developed to adjust weaning weights of calves to mature age-of-dam equivalent were: 25, 10, 7, and 15 pounds for steers from 2-, 3-, 9-, and 10-year-old cows, respectively; and 30, 20, and 10 pounds for heifers from 2-, 3-, and 10-year-old cows, in that order.

i. An influence of differences in season of birth was reflected in birth weights and in post-weaning gains. Each day lapse from January 1 to birth of the calf was associated with .08 pound increase in birth weight. This influence was compensated during the suckling period, but again was expressed in post-weaning gains. It was recommended that the breeding season be limited to two or three heat periods to minimize this effect and to eliminate cows which are hard to settle.

j. The influences of age of cow at first calving and whether a cow raised a calf in the previous year were not consistent. Opposing estimates of these effects were obtained in the separate analyses of steer and heifer data. No conclusions were drawn relative to the meaning of results obtained.

12. In cooperation with Anglemier, of Food and Dairy Technology, enzyme activity of the following has been determined on blood serum of calves at each 100-pound increment from birth to 800 pounds body weight:

Lipase
Amylase
Acid phosphatase
Alkaline phosphatase
Glutamic oxalacetic transaminase
Glutamic pyruvic transaminase

13. Test gains, total gains, and final weights of 330 bull and heifer calves from the University of Wyoming experimental beef herd, which include two lines of Herefords and one line each of Angus and Shorthorns, were subjected to analyses by methods of least squares to determine the relative magnitude of various physiological influences. Four analytical models were used to provide comparisons of the influence of birth weight and suckling gain when considered singly, in combination, or when both were ignored. Using the least squares estimates, the original values of

test and total gains and final weights were adjusted to a common basis and a paternal half-sib analysis of variance was employed to determine the genetic, environmental, and phenotypic variance, covariance and correlations of the three post-weaning performance traits. Comparisons between models illustrated the effects of adjusting for birth weight and suckling gain difference. Heritability estimates for each trait could be made. On the basis of the experimental results, the following conclusions were drawn:

a. Test gains are subject to unmeasured influences to a greater extent than either total gain or final weight. Neither birth weight nor suckling gain has a marked influence on test gains, as reflected by the coefficients of determination, whereas both total gain and final weight are especially affected by differences in suckling gains.

b. Calves from two-year-old dams consistently had significantly lower gains and final weight than calves from older cows. No indication of compensatory growth was evidenced in connection with the offspring from two-year-old dams.

c. Large yearly differences suggest a possible decline in production due to inbreeding. Increased test gains as a result of lowered suckling gains are indicated in some years.

d. Bulls consistently out-perform heifers with increases up to 63 pounds of test gain, 89 pounds of total gain, and 94 pounds of final weight.

e. Shorthorns out-produced the other breeds. Angus and Laramie Herefords perform about equally, but Gillette Herefords were consistently the poorest producers, due in part to a high rate of inbreeding.

f. Weaning age has no effect on test gains. When differences in suckling gains are ignored, a 10-day increase in weaning age accounts for an increase in total gain and final weight of up to 17 pounds.

g. Test gains and total gains are each increased about 12 pounds by a 10-pound increase in birth weight. Final weight under the same conditions is increased from 22 to 29 pounds depending on the analytical model.

h. An additional one pound in post-weaning gain and final weight results from each 10-pound increase in suckling gain.

i. Heritability estimates essentially are zero for test gain under the assumptions of the various analyses. Total gain and final weight estimates of heritability are small but should be high enough to allow for selection progress.

j. There probably is an extremely high genetic correlation between suckling and test gains so that elimination of the genetic variance of suckling gains drastically reduces the genetic variance of test gains.

k. A positive negative genetic correlation between birth weight and test gain is postulated such that the elimination of the genetic variance of suckling gains when birth weight is allowed to vary will result in a decrease in the genetic variance of all traits.

l. When suckling gains are considered but birth weight differences are ignored, heritability estimates for test gain, total gain, and final weight are at a minimum. Therefore, selection for these traits is advisable only when suckling gains and birth weight differences are both adjusted or preferably both ignored.

m. Extremely high genetic correlations between test gains and total gains indicated a high positive genetic correlation between pre- and post-weaning gains.

n. Selection on the basis of yearling weight should lead to increased gains prior to weaning and especially after weaning.

VI. Work Planned for the Future:

1. It is planned that the study dealing with growth patterns of cattle will be completed during the next year and the material will be prepared for publication. The study entailed the development of a mathematical description of normal growth and feed efficiency, and the analysis of factors which contributed to variation in both growth and feed efficiency. This material will be published by Kidwell, Shelby, and Bogart, representing a cooperative effort.

2. Analysis of blood serum for total protein a, β, and γ globulin and urea nitrogen will be run on calves at birth and at each 100-pound increment until they reach 800 pounds body weight. The results of these analyses will be related to growth, feed efficiency, sex, and line of breeding.

3. The study of enzymatic activity as a basis of understanding why some animals are superior to others in growth performance can be made either by measuring enzymes in the blood directly or by measuring the metabolites and precursors. Since the studies on phosphatase enzymes have appeared so enlightening, it is planned to expand the studies directly to enzyme analysis. In addition, cholesterol and phospholipids will be determined and their values related to values in performance traits.

4. It appears that blood levels of glucose do not influence or control appetite. The next logical approach is to study the relation of volatile fatty acids to appetite. The plan is to determine volatile fatty acid

levels in the blood of the calves on test and to relate this to daily feed intake. In addition, the level of fatty acids in the blood will be increased and then decreased to determine if this will alter appetite.

5. The three lines of Herefords and one line of Angus at Corvallis, and one line of Herefords at Union will be continued. Two bulls will be used in each of the four lines at Corvallis. Selection is based on an index in which suckling gains, feed-test gains, feed efficiency, and score for type and conformation are given equal weight and is used along with minimum culling levels for fertility and freedom from defects. All cattle will be weighed each week until a weight of 800 pounds is reached. All calves will be scored, measured, and photographed at 500 and at 800 pounds body weight. Cows will be culled primarily on the basis of the production and performance of their calves, and they will be replaced with the best young females within the line. Since it appears that iodized salt may be necessary for some lines of breeding and that its deficiency which results in a hypothyroid state may lead to the development of hydrocephalus, a program will be developed to determine whether this working hypothesis is true. The Prince cows that were mated to the Prince bull which sired the calves with hydrocephalus will be remated to this same bull. In addition, some of the Prince cows previously culled also will be mated to him. Half of these cows will be fed iodized salt and half noniodized salt. Also, half of the commercial herd of cows bred to a bull completely unrelated to them or to any of the lines in the breeding project will be fed iodized salt and the other half will be fed noniodized salt through the winter. All other cows in all of the lines will be fed iodized salt. If calves with hydrocephalus are produced in the Prince line on noniodized salt but none with hydrocephalus in the ones receiving iodized salt, and also none in the ones mated to an unrelated bull, it will show the following:

a. a genetic-nutrition interaction--a need for iodized salt by some genotypes but not by others

b. iodized salt can prevent the expression of an hereditary abnormality

c. thyroid function is related to the development of hydrocephalus

6. Cows at the Eastern Oregon Station, Union, will be bred to a bull of each of the three Hereford lines at Corvallis and the Hereford line at Union. In addition to age and weight of each calf at weaning, data on post-weaning performance will be obtained. Three bull calves by each sire will be fed individually to obtain data on rate and efficiency of gains. The steers by each sire will be fed out and rate of gain and carcass evaluations will be obtained. Heifers by each sire will be retained in the herd and their calves will be appraised at weaning to evaluate these heifers for cow productivity. Cows at the John Jacob Astor Station, Astoria, will be bred to bulls of the David and Prince lines, and their progeny will be appraised at weaning. Heifers that are kept for replacements will be appraised for their abilities to produce good calves.

7. One outstanding example of a chronic-bloating bull exists from which semen will be frozen for mating to females that have bloated and also to females sired by a bloater bull. The rumen contents of bloater and normal animals will be studied in artificial rumens to determine if the microflora from the two kinds of animals function differently in digestion and gas production.

8. Every effort will be made to provide better feed for the cattle during the feed test so that normal consumptions of food will be obtained.

9. Effort will be concentrated on the analysis of data. All data will be put on IBM cards so that analyses can be made.

VII. Publications and Manuscripts:

Bogart, Ralph, Frank Hudson, Hugh Nicholson, R. W. Mason, and Hugo Krueger. 1958. Effect of injected testosterone on fertility in female cattle and sheep. Internatl. J. Fert. 3:105-119.

Bogart, Ralph, R. W. Mason, H. H. Nicholson, and Hugo Krueger. 1958. Genetic aspects of fertility in mice. Internatl. J. Fert. 3:86-104.

Hudson, Frank A. 1958. Anesthesia time as a measure of body fat in genetically different groups of lambs. Diss. Abs. 19:399-400.

Mason, R. W., H. H. Nicholson, Ralph Bogart, and Hugo Krueger. 1958. Preponderance of hybrid losses or negative heterosis in mouse crosses. Fourth Internatl. Symposium on Biometrical Genet. Proc. Ottawa, Canada.

Price, D. A. 1958. Chemical and cellular constituents in the blood of genetically different lines of growing beef cattle. Diss. Abs. 19:619.

Alexander, G. I., and Ralph Bogart. 1959. Effects of inbreeding on performance characteristics in inbred lines of beef cattle. (Abs.) J. Anim. Sci. 18:1164.

Dhannasiri, Tim. 1959. Haematological study of genetically different lines of growing beef cattle. Ph. D. Thesis. Oregon State College. Corvallis.

Bogart, Ralph. 1959. Beef cattle breeding research at Oregon State College. Beef Cattle and Swine Field Days, May 18 and 19.

Casida, L. E., F. N. Andrews, Ralph Bogart, M. T. Clegg, and A. V. Nolbandov. 1959. Hormonal relationships and applications in the production of meats, milk, and eggs. Natl. Acad. Sci., Natl. Res. Council P. 714.

de Baca, Robert Luciano. 1959. Genetic, environmental, and residual maternal influences on cow productivity and growth of calves. Ph. D. Thesis. Oregon State College. Corvallis.

de Baca, R. C., and Ralph Bogart. 1959. Factors affecting condition and conformation of crossbred spring lambs. J. Anim. Sci. 18:1094-1102.

de Baca, R. C., Ralph Bogart, W. A. Sawyer, and Farris Hubbert, Jr. 1959. The expression of growth compensations for environmental influences affecting gains of steers. (Abs.) J. Anim. Sci. 18:1536.

Krueger, Hugo, and Ralph Bogart. 1959. Testosterone, inhibition of ovulation in heifers. Pharmacol. 1(3):.

Sabin, Samuel Waybright. 1959. Analyses of physical sources of variation in estimated genetic growth parameters in beef cattle. Ph. D. Thesis. Oregon State College. Corvallis.

Van Arsdel, W. C., Hugo Krueger, and Ralph Bogart. 1959. Lead selection. cardiac axes, and interpretation of electrocardiograms in beef cattle. Oreg. Agr. Expt. Sta. Tech. B. 51.

Alexander, G. I., and Ralph Bogart. Effect of inbreeding on performance characteristics in inbred lines of beef cattle. (Manuscript prepared.)

Bhannasiri, Tim, Ralph Bogart, and Hugo Krueger. Haemoglobin and blood cells of growing beef cattle. (Manuscript prepared.)

Ray, Earl E., Ralph Bogart, and Hugo Krueger. The response of different strains of mice to testosterone. (Manuscript prepared.)

Cattle Inventory PROJECT SUMMARY
Purebred Oregon Agricultural Experiment Station Date: 5-23-60

Breed	Hereford	Hereford	Hereford	Angus
Line	Lionheart	Prince	David	
Station	Central	Central	Central	Central
Bulls (12 mos. or over)	5	4	4	7
Cows (2 yrs. or over)	19	16	19	27
Heifers, yearlings	10	6	5	11
Bull calves	3	1	7	14
Heifer calves	9	2	4	12
Percentage used for breeding project	60	60	60	60
Estimated cash value	$10,250	$13,450	$15,300	$24,700
Grade	None	None	None	None

Cow Production Data Oregon Agricultural Experiment Station

Breed	Hereford				Angus			
Line	Lionheart				Prince			
Cows bred to calve as 2-yr.-olds	3				0			
Calves born from 2-yr.-olds								
Alive	1				0			
Dead	0				0			
Cows bred to calve at 3 yrs. and up	16				16			
Calves born from 3-yr.-olds and up								
Alive	14				10			
Dead	0				1			
All calves born								
Alive	14				10			
Dead	0				1			
Total	14				11			
Calves weaned	13				7			
Percent calf crop								
Birth	87.50				62.50			
Weaning	81.25				56.25			
	Bulls		Heifers		Bulls		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Average:								
Birth weight	3	64.3	11	68.6	3	67.0	7	64.7
Weaning age	212.67		209		181.67		190.8	
Weaning weight	3	351.0	10	369.7	3	340.0	6	370.0
Adjusted weaning weight - 180 days	-		-		-		-	
Weaning score:								
Condition	3	10.47	10	10.87	3	10.89	6	11.10
Conformation	3	11.78	10	11.39	3	12.33	6	11.61

Cow Production Data Oregon Agricultural Experiment Station

Breed	Hereford				Angus			
Cows bred to calve as 2-yr.-olds	4				4			
Calves born from 2-yr.-olds	3				4			
Alive	3				4			
Dead	0				0			
Cows bred to calve at 3 yrs. and up	16				23			
Calves born from 3-yr.-olds and up								
Alive	12				19			
Dead	0				0			
All calves born								
Alive	12				19			
Dead	0				0			
Total	12				19			
Calves weaned	10				17			
Percent calf crop								
Birth	75.00				82.61			
Weaning	62.50				73.91			
	Bulls		Heifers		Bulls		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Average:								
Birth weight	3	56.3	6	62.3	6	56.7	12	55.0
Weaning age		198.6		208		196.1		211.1
Weaning weight	3	383.3	6	336.7	6	416.0	11	366.9
Adjusted weaning weight - 180 days		-		-		-		-
Weaning score:								
Condition	3	9.86	6	11.02	6	11.46	11	10.59
Conformation	3	10.80	6	11.09	6	12.16	11	10.93

Feed-lot Performance Date: 5-23-60

Breed	Hereford	Hereford	Hereford	Hereford	Hereford	Hereford
Line	Lionheart	Lionheart	Prince	Prince	David	David
Sex	Male	Female	Male	Female	Male	Female
Number on test	3	10	3	6	3	6
Average:						
Age on test	244.67	287.4	276.3	284.5	288.0	301.5
Initial weight	500	500	500	500	500	500
Initial score:						
Condition	10.47	10.87	10.89	11.10	9.86	10.16
Conformation	11.78	11.39	12.33	11.61	10.80	10.29
Days on test*						

* Data not included as approximately half of the calves were still on test at the time this report was prepared.

Feed-lot Performance Oregon Agricultural Experiment Station Date: 5-23-60

Breed	Angus	Angus
Line		
Sex	Male	Female
Number on test	6	11
Average:		
Age on test	232.1	288.8
Initial weight		
Initial score:		
Condition	11.46	10.59
Conformation	12.16	10.93
Days on test*		

* Data not included as approximately half of the calves were still on test at the time this report was prepared.

Young Animals on Feed Date: 5-23-60
Purebred

	Hereford	Angus
	Number Individually Fed	Number Individually Fed
Bulls	9	6
Heifers	20	11
Grade	None	None

Land, Physical Facilities, and Equipment Used Date: 5-23-60

Item	Number	Actual Cash Value	Percentage Used for Breeding Project
Land--Irrigated pasture	64 acres	$400/acre	60
Dry land pasture	140 acres	$300/acre (av.)	60
Barns and lots		$730	60
Squeeze chutes	2 only	$750	60
Feed carts	1 only	$100	100
Truck	1 only	$1,400	15
Loading chute	1 only	$500	25
Trailer	1 only	$450	20
Portable scales	1 only		50
Misc. equipment & supplies		$350	25

U. S. RANGE LIVESTOCK EXPERIMENT STATION

I. Station: U. S. Range Livestock Experiment Station, Miles City, Montana

II. Project Titles:

APH d1-1 Rev. The development and testing of methods of measuring performance in beef cattle

APH d1-2 Rev. The development of superior lines of beef cattle

III. Personnel:

U. S. Range Livestock Experiment Station, Miles City, Montana
J. R. Quesenberry, R. R. Woodward, Nat M. Kieffer, and F. J. Rice

Office of Coordinator:
R. T. Clark, Coordinator, and J. S. Brinks

IV. and V. Nature and Extent of Work Done This Year, and Summary of Progress and Conclusions to Date:

Project APH d1-1 Rev. The development and testing of methods of measuring performance in beef cattle

The major emphasis in this project is the development of methods of evaluating meat quality in the live animal. Body form measurements, rib eye tracings, and color and yield determinations were made at time of slaughter. Rib samples were obtained and sent to the Meats Laboratory at Beltsville where physical separation and cooking evaluations were obtained.

Nine sire groups consisting of 61 weanling steer calves of Hereford, Charollais, Brown Swiss, and Brown Swiss × Hereford breeding were placed on feed October 28, 1959. These steers are being group fed within breeds and will be slaughtered in early July of 1960.

Project APH d1-2 Rev. The development of superior lines of beef cattle

Several top-cross tests are under way. Comparable preweaning data from Miles City bulls and bulls from other sources will be collected in herds in three Western States this year.

In 1958-59, five sire groups of Hereford steers, two sire groups of Charollais-Hereford steers (out of Hereford cows), and one group of Charollais steers were compared for both preweaning and postweaning performance and for carcass merit. The results of these comparisons are shown in the following table.

Comparison of Hereford, Charollais, and Charollais × Hereford Steers for Various Traits

Breed Sire	Hereford (5 sire gps.)	Ch × H 859	Ch × H 861	Charollais
Number of steers	36	6	8	7
Average weaning weight	396	458	476	451
ADG (252-day test)	2.34	2.51	2.82	2.38
Final feed-lot weight	999	1031	1218	1034
Average percent yield	62.6	63.8	60.9	63.4
Average carcass grade	L. Ch.	H. Good	H. Good	M. Good
Av. Composition 9-11 rib				
Percent lean	47.1	49.1	50.9	53.2
Percent fat	33.7	30.8	29.7	26.4
Percent bone	19.3	20.1	19.4	20.4
Av. shear value 1/	12.0	14.0	11.5	13.9

1/ Low value most tender

The 180-day adjusted weaning weights of the Charollais steers were 14 percent heavier than those of the Herefords, whereas the weaning weights of the crossbred calves were an average of 18 percent heavier.

The crossbred steers dressed out approximately one percent less than the Herefords, whereas the Charollais steers had a dressing percentage approximately one percent greater. The Herefords graded an average of Low Choice. Both crossbred groups graded High Good and the Charollais averaged Good. The Charollais steer carcasses contained six percent more lean meat than did the Herefords, but several individuals were definitely under finished. The carcasses of the crossbred steers contained from two to three percent more lean.

VI. Work Planned for the Future:

A new line of cattle selected for superior carcass merit has been formed this year. The cows selected to go into this line were taken from the present grade herd. These animals were selected on the basis of the carcasses of their progeny. The bull being used this year is a son of the bull whose progeny have excelled all other sire groups tested in carcass merit.

Thirty-two yearling Charollais heifers were purchased this spring to augment our present Charollais herd. Also, 14 Brown Swiss cows have been purchased. These additions will give us adequate numbers in each breed to initiate the breed appraisal project outlined in 1958.

The results of the analysis of carcass data indicate that another approach would be advisable in studying carcass characteristics. Starting with the steers to go on feed this fall, the steers will be slaughtered locally as they reach 1,000 pounds live weight. The same body form measurements will be obtained as in the past.

VII. Publications and Manuscripts:

Woodward, R. R., and R. T. Clark. 1959. A study of stillbirths in a herd of range cattle. J. Anim. Sci. 18(1):85-90.

Woodward, R. R. 1959. A preliminary look at Charollais. Mont. State Col. Fifth Annu. Beef Prod. Sch. Proc. 5:.

Woodward, R. R. 1959. We need to remodel our livestock. Farm Profit, 4(5):2-3.

Shelby, C. E., R. T. Clark, J. R. Quesenberry, and R. R. Woodward. 1960. Heritability of some economic characteristics in record of performance bulls. J. Anim. Sci. 19:450.

Cattle Inventory PROJECT SUMMARY Date: June 21, 1960

Purebred U. S. Range Station Agricultural Experiment Station

Breed	Hereford	H	H	H	H
Line	1	4	5	6	9
Station	U. S. Range Station				
Bulls (12 mos. or over)	14	4	2	2	3
Cows (2 yrs. or over)	175	25	0	23	33
Heifers, yearlings	63	11	8	10	15
Male calves	55	12	0	6	9
Heifer calves	54	7	0	7	7
Percentage used for breeding project	100	100		100	100
Estimated cash value	$119,010	(Total)			

Grade

Breed	Hereford	Br. Swiss	Char.	H × Ch	Hereford
Line	Unregistered	Br. Swiss	Char.	H × Ch	Culls
Station	U. S. Range Station				
Bulls (12 mos. or over)	0	2	2	0	0
Cows (2 yrs. or over)	210	29	25	15	120
Male calves	77	4	10	4	64
Heifer calves	65	10	11	8	51
Percentage used for breeding project	80	80	80	80	0
Estimated cash value	$75,178	(Total)			

Cattle Inventory (Continued) PROJECT SUMMARY Date: 6-21-60

Purebred U. S. Range Station Agricultural Experiment Station

Breed	H	H	H	H
Line	10	11	12	14
Station	U. S. Range Station			
Bulls (12 mos. or over)	5	3	3	2
Cows (2 yrs. or over)	29	36	38	41
Heifers, yearlings	11	12	15	9
Male calves	6	12	15	22
Heifer calves	10	9	7	10
Percentage used for breeding project	100	100	100	100
Estimated cash value	$119,010 (Total)			

Cow Production Data 1959 calf crop

Breed	Hereford	Hereford
Line	L1	L4
Cows bred to calve at 3 yrs. and up	171**	32
Calves born		
Alive	130	23
Dead	6	1
All calves born		
Alive	130	23
Dead	6	1
Total	136	24
Calves weaned	130	21
Percent calf crop*		
Birth	79.5	75.0
Weaning	76.0	65.6

	Bulls		Steers		Heifers		Bulls		Steers		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Average:												
Birth weight	33	81.4	37	78.6	66	74.7	3	83.3	8	77.9	13	70.7
Weaning age		190.1		183.4		189.8		188.0		178.3		185.5
Weaning weight	33	468.6	33	417.9	64	416.5	3	424.7	7	361.7	11	349.8
Adj. weaning wt. - 180 days		441.4		420.6		398.7		410.0		365.9		340.7
Weaning score												
Desirability	33	2-	33	2-	64	2	3	2-	7	2-	11	2-
Uniformity	33	2-	33	2-	64	2	3	2-	7	2-	11	3+

* $\frac{\text{No. calves}}{\text{No. cows bred}}$

** Includes cows culled or died between breeding season and calving season.

Cow Production Data (Cont'd) U.S. Range Station Agricultural Expt. Station

Breed	Hereford	Hereford
Line	L5	L6
Cows bred to calve at 3 yrs. and up	21	33
Calves born from 3-yr.-olds and up		
Alive	17	31
Dead	2	0
All calves born		
Alive	17	31
Dead	2	0
Total	19	31
Calves weaned	16	29
Percent calf crop*		
Birth	90.5	93.9
Weaning	76.2	93.5

	Bulls		Steers		Heifers		Bulls		Steers		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Average:												
Birth weight	4	74.5	6	68.5	9	70.7	5	64.2	15	62.6	11	57.6
Weaning age		194.0		180.8		194.9		175.8		183.5		194.8
Weaning weight	4	414.5	4	348.5	8	357.1	5	397.6	14	372.7	10	364.1
Adj. weaning wt. - 180 days		398.5		348.5		335.3		407.6		368.6		345.6
Weaning score												
Desirability	4	2	4	2	8	2	5	2-	14	2-	10	2+
Uniformity	4	2	4	2	8	2-	5	2-	14	2-	10	2+

* $\frac{\text{No. calves}}{\text{No. cows bred}}$

U. S. Range Station Agricultural Experiment Station

Cow Production Data (Continued) 1959 calf crop

Breed	Hereford	Hereford
Line	L9	L10
Cows bred to calve as 2-yr.-olds	-	-
Calves born from 2-yr.-olds		
Alive	-	-
Dead	-	-
Cows bred to calve at 3 yrs. and up	42	34
Calves born from 3-yr.-olds and up		
Alive	37	29
Dead	1	0
All calves born		
Alive	37	29
Dead	1	0
Total	38	29
Calves weaned	36	29
Percent calf crop*		
Birth	90.5	85.3
Weaning	85.7	85.3

	Bulls		Steers		Heifers		Bulls		Steers		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Average:												
Birth weight	7	74.3	15	73.5	16	70.6	10	77.2	8	78.0	11	71.5
Weaning age		191.4		74.5		186.3		188.1		181.5		181.7
Weaning weight	7	453.4	14	370.1	15	391.1	10	413.1	8	351.9	11	364.7
Adj. weaning wt. - 180 days		430.6		379.5		376.6		398.5		348.0		359.5
Weaning score												
Desirability	7	2	14	2	15	2-	10	3	8	3	11	2-
Uniformity	7	2-	14	2-	15	2-	10	2-	8	2-	11	2

*Please indicate the method used in calculation.

U. S. Range Station Agricultural Experiment Station

Cow Production Data (Continued) 1959 calf crop

Breed	Hereford	Hereford
Line	L11	L12
Cows bred to calve as 2-yr.-olds	-	-
Calves born from 2-yr.-olds		
Alive	-	-
Dead	-	-
Cows bred to calve at 3 yrs. and up	29	35
Calves born from 3-yr.-olds and up		
Alive	23	29
Dead	2	4
All calves born		
Alive	23	29
Dead	2	4
Total	25	33
Calves weaned	23	28
Percent calf crop*		
Birth	86.2	94.3
Weaning	79.3	80.0

	Bulls		Steers		Heifers		Bulls		Steers		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Average:												
Birth weight	8	80.0	4	77.8	13	69.1	4	85.3	12	88.2	17	78.2
Weaning age		198.9		178.0		191.7		178.3		182.0		187.3
Weaning weight	8	474.1	3	410.0	12	407.8	4	428.0	9	405.8	15	424.1
Adj. weaning wt. - 180 days		440.0		419.8		393.1		433.8		394.2		402.2
Weaning score												
Desirability	8	2+	3	2+	12	2+	4	2	9	2	15	2
Uniformity	8	2+	3	2+	12	2	4	2	9	2	15	2

*Please indicate the method used in calculation.

U. S. Range Station Agricultural Experiment Station

Cow Production Data (Continued) 1959 calf crop

Breed	Hereford	Charollais
Line	L14	-
Cows bred to calve as 2-yr.-olds	-	-
Calves born from 2-yr.-olds		
Alive	-	-
Dead	-	-
Cows bred to calve at 3 yrs. and up	23	19
Calves born from 3-yr.-olds and up		
Alive	21	17
Dead	2	0
All calves born		
Alive	21	17
Dead	2	0
Total	23*	17
Calves weaned	19	16
Percent calf crop**		
Birth	100.0	89.5
Weaning	82.6	84.2

	Bulls		Steers		Heifers		Bulls		Steers		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Average:												
Birth weight	5	78.4	7	77.1	10	73.5	5	90.2	5	79.4	7	79.0
Weaning age		193.0		192.2		194.8		182.8		189.8		176.6
Weaning weight	5	445.4	5	385.6	9	382.4	5	514.0	4	498.8	7	416.1
Adj. weaning wt. - 180 days		420.8		365.1		361.5		508.2		475.4		421.0
Weaning score												
Desirability	5	2	5	2	9	2-	5	2	3	2	7	2
Uniformity	5	3+	5	3+	9	2-	5	2	3	2	7	2+

* 1 stillborn calf--sex not recorded.

** Please indicate the method used in calculation.

U. S. Range Station ___ Agricultural Experiment Station

Cow Production Data (Continued) 1959 calf crop

Breed	Hereford	Hereford
Line	Grade	H. × Br. Sw.
Cows bred to calve as 2-yr.-olds	-	-
Calves born from 2-yr.-olds		
Alive	-	-
Dead	-	-
Cows bred to calve at 3 yrs. and up	180	30
Calves born from 3-yr.-olds and up		
Alive	155	27
Dead	1	1
All calves born		
Alive	155	27
Dead	1	1
Total	156	28
Calves weaned	151	27
Percent calf crop*		
Birth	86.7	93.3
Weaning	83.9	90.0

	Bulls		Steers		Heifers		Bulls		Steers		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Average Birth weight	-	-	89	81.1	67	77.1	-	-	15	91.4	13	79.2
Weaning age	-			180.1		182.7	-			185.1		186.4
Weaning weight	-	-	84	396.6	67	391.8	-	-	14	460.1	13	395.7
Adj. weaning wt. - 180 days	-			396.6		383.1	-	-		451.4		385.2
Weaning score												
Desirability	-	-	84	2	67	2+	-	-	14	3+	13	3
Uniformity	-	-	84	2	67	2	-	-	14	3+	13	2-

* Please indicate the method used in calculation.

U. S. Range Station Agricultural Experiment Station

Cow Production Data (Continued) 1959 calf crop

Breed	Brown Swiss
Line	-
Cows bred to calve as 2-yr.-olds	-
Calves born from 2-yr.-olds	
Alive	-
Dead	-
Cows bred to calve at 3 yrs. and up	15
Calves born from 3-yr.-olds and up	
Alive	12
Dead	1
All calves born	
Alive	12
Dead	1
Total	13*
Calves weaned	12
Percent calf crop**	
Birth	86.7
Weaning	80.0

	Bulls		Steers		Heifers		Bulls		Steers		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Average:												
Birth weight	-	-	4	97.8	8	83.8						
Weaning age	-			179.0		184.3						
Weaning weight	-	-	4	443.8	8	468.1						
Adj. weaning wt. - 180 days	-			439.8		461.8						
Weaning score												
Desirability	-	-	4	3+	8	3+						
Uniformity	-	-	4	3	8	2-						

* One calf not weighed at birth.

** Please indicate the method used in calculation.

U. S. Range Station Agricultural Experiment Station

Feed-lot Performance Date: June 21, 1960

Breed	Hereford	Hereford	Hereford	Hereford	Hereford
Line	1	4	5	6	9
Sex	Bull	Bull	Bull	Bull	Bull
Number on test	32	3	3	5	7
Average:					
Age on test	200.3	198.0	204.0	185.8	201.4
Initial weight	448.0	434.3	405.0	385.6	445.1
Initial score					
Desirability	2-	2-	2	2-	2
Uniformity	2-	2-	2	2-	2-
Days on test	196	196	196	196	196
Gain per head					
Total	490.4	517.7	467.7	438.2	441.1
Average daily gain	2.50	2.06	2.39	2.24	2.25
Efficiency of feed utilization					
Lbs. TDN/100 lbs. gain or Lbs. gain/100 lbs. TDN	22.83	22.83	22.48	22.77	20.85
Average:					
Final weight	938.4	952.0	872.7	823.8	886.3
Final score					
Conf.	2	2-	2-	2	2

U. S. Range Station Agricultural Experiment Station

Feed-lot Performance (Continued) Date: June 21, 1960

Breed	Hereford	Hereford	Hereford	Hereford	Charollais
Line	10	11	12	14	-
Sex	Bull	Bull	Bull	Bull	Bull
Number on test	10	6	4	5	5
Average:					
Age on test	198.1	212.0	188.3	203.0	192.8
Initial weight	404.1	465.3	418.8	437.6	507.4
Initial score					
Desirability	3	2+	2	2	2
Uniformity	2-	2+	2	3+	2
Days on test	196	196	196	196	196
Gain per head					
Total	482.8	451.2	502.5	535.8	472.0
Average daily gain	2.46	2.30	2.56	2.73	2.41
Efficiency of feed utilization					
Lbs. TDN/100 lbs. gain or					
Lbs. gain/100 lbs. TDN	23.00	21.35	24.16	24.49	21.95
Average:					
Final weight	886.9	916.5	921.0	973.4	979.4
Final score					
Conf.	2-	2	2-	2	2

U. S. Range Station Agricultural Experiment Station

Young Animals on Feed Date: June 21, 1960

Purebred	Hereford		Br. Sw. × Hereford	Charollais		Brown Swiss
	No. ind. fed	No. group fed	No. group fed	No. ind. fed	No. group fed	No. group fed
Bulls	75			5		
Heifers						
Steers						
Grade						
Bulls						
Heifers						
Steers		48	8		3	3

Land, Physical Facilities, and Equipment Used Date: June 21, 1960

	Number	Actual Cash Value	Percentage Used for Breeding Project
Land	56,000 acres	$ 812,500	92
Buildings, corrals, land improvements, fence, residences, etc.	-	2,500,000	92

UTAH STATE UNIVERSITY

I. Station: Utah Agricultural Experiment Station, Logan, Utah

II. Project Title: The development of breeding techniques and selection criteria for improvement of economically important characteristics in Hereford and Shorthorn cattle

III. Personnel:

Experiment Station:
James A. Bennett, and Doyle J. Matthews

U. S. Department of Agriculture:
R. T. Clark, Coordinator

IV. Nature and Extent of Work Done This Year:

The development of lines of Hereford and Shorthorn cattle through a system of mild inbreeding accompanied by selection based on performance, was continued according to plan. A group of some 16 dwarf carrier cows also was maintained.

The level of inbreeding gradually is increasing in the lines. The Hereford line shows an average inbreeding coefficient of approximately 5 percent as calculated through the last four generations. A value of about 9.5 percent is found in the Shorthorns over the same generations. Forty percent of the Shorthorn calves showed values of over 10 percent.

An outcross bull of high gaining ability and ample size for age was tested on these cows and found to be a dwarf carrier. Gains of the bulls on the performance test were studied in detail for the age interval of 250 to 390 days of age. Gains over 4-week periods throughout this interval were compared. Daily gains in the Shorthorn bulls were not significantly different between periods, indicating that daily gain is approximately linear. Significant gains between periods were found for Hereford bulls, however. Gains during the first period, 250-278 days of age, were distinctly lower than those for the other periods. These gains in the early part of the test occurred although the calves had a minimum of a four-week adjustment period prior to the start of the test.

Instantaneous growth rates were calculated and studied over this same period of time. This measure of growth shows a decline as age advances and there is some indication in the Shorthorns that a sharp decline takes place in the 362-390 age interval. Herefords did not show as marked a decrease at this time period.

Feeding one pound of long grass hay per bull per day along with the balance of the ration in a pellet proved very satisfactory. One-half of the hay was given in the morning and one-half in the evening. Minor cases of

bloat appeared in only two animals out of 44 that were fed in this manner. The small quantity of grass hay offered is readily eaten and weigh backs are rarely necessary.

Some studies have been initiated to measure the influence of some environmental factors upon tenderness and marbling in beef. The first factor being tested is the rate of gain in the animals in the immediate pre-slaughter period. Uniform groups of long yearling are being fed to gain at different rates during the last 28 days prior to slaughter. Twenty animals are involved in this first test. They have been slaughtered and tenderness scores will be available within a week.

V. Summary of Progress and Conclusions to Date:

Development of lines of Hereford and Shorthorn cattle is moving ahead. Dwarfism is still a problem in one line of Herefords but appears to be rare in the other Hereford line. No dwarfism has been observed in the Shorthorns. The Shorthorns have been consistently heavier at weaning than the Herefords. It is felt that improvement in weaning weight is being made in the Herefords.

This project has provided a means of stimulating interest among commercial and purebred cattlemen in the state in increasing the productiveness of cattle. The program was extended to on-the-farm testing this past year. Over 600 beef animals completed official tests in cooperation with the Utah Agricultural Extension Service. Interest is strong and this program definitely will increase in size.

Tritium and NAAP (N-acetyl-4-amino antipyrine) both have been shown to be reasonably accurate for a basis of estimating the percentage of fat in live beef animals. However, more reliable and more simple methods would be desirable.

Work at this station also has shown that biochemical analysis of body fluids may have promise for identifying genotypes in regard to dwarfism, and encouraging leads have been obtained in this direction.

Application of Findings

This project will furnish information on the value of mild inbreeding accompanied by selection for improving productiveness in cattle. It already has demonstrated to cattlemen how performance testing may be used advantageously, and it has served as a means of helping to convert cattlemen in the state to performance testing. Many cattlemen now are embarking on testing programs.

Adjustment values for several environmental factors influencing weaning weight are helpful to the cattlemen in the area in improving the accuracy of selection for this characteristic.

Results of biochemical studies of body fluids and of chemical methods of estimating body composition in live cattle should be helpful in providing an understanding of the basic causes of growth rate differences in productive ability.

VI. Work Planned for the Future:

1. Continue the development of Hereford and Shorthorn cattle

2. Study in detail the growth rate in beef cattle

3. Study the influence of environmental and heredity factors upon tenderness and marbling in beef

4. Attempt to develop a more accurate and simple method of estimating body composition in live cattle

5. Encourage and assist extension livestock specialist in expanding the state program in performance testing

VII. Publications and Manuscripts:

Utah Agricultural Experiment Station
1960. Performance testing results. A field day report. Utah Agr. Expt. Sta. and Ext. Serv. Mimeog. Rpt.

Cattle Inventory PROJECT SUMMARY
Purebred Utah Agricultural Experiment Station Date: 6-30-60

Breed	Hereford	Hereford	Shorthorn
Line	I	II	I
Station	Logan	Panguitch	Logan
Bulls (12 mos. or over)	2	6	6
Cows (2 yrs. or over)	25	48	27
Heifers, yearlings	8	9	10
Bull calves	11	25	10
Heifer calves	10	21	25
Percentage used for breeding project	90	100	90
Estimated cash value	$10,250	$20,230	$13,950

Cow Production Data Utah Agricultural Experiment Station

Breed	Hereford	Hereford
Line	I	II
Cows bred to calve as 2-yr.-olds	5	10
Calves born from 2-yr.-olds		
Alive	3	9
Dead	0	0
Cows bred to calve at 3 yrs. and up	22	39
Calves born from 3-yr.-olds and up		
Alive	17	36
Dead	2	0
All calves born		
Alive	20	45
Dead	2	0
Calves weaned*	20	42
Percent calf crop		
Birth	81	92
Weaning	74	86

	Bulls		Steers		Heifers		Bulls		Steers		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Average:												
Birth weight	6	69	4	68	12	69	19	66	3	68	20	65
Weaning age	231		240		228		210		232		250	
Weaning weight	4	413	4	415	12	447	19	445	3	445	20	385
Adj. weaning weight - 180 days	449		454		459		465		429		415	
Weaning score												
Cond.	4	2.4	4	2.1	12	2.0	19	2.0	3	2.1	20	2.1
Conf.	4	2.2	4	2.2	12	2.1	19	1.96	3	2.0	20	2.3

* Based on number of cows placed in breeding pasture minus those removed for some cause other than being barren. If a cow that is removed is barren, she is counted in the "cows bred" group.

Cow Production Data Utah Agricultural Experiment Station

Breed	Shorthorn
Line	I
Cows bred to calve as 2-yr.-olds	8
Calves born from 2-yr.-olds	
Alive	5
Dead	2
Cows bred to calve at 3 yrs. and up	23
Calves born from 3-yr.-olds and up	
Alive	22
Dead	0
All calves born	
Alive	27
Dead	2
Total	29
Calves weaned*	26
Percent calf crop	
Birth	93
Weaning	84

	Bulls		Steers		Heifers		Bulls		Steers		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Average:												
Birth weight	14	69	6	69	9	69						
Weaning age		210		240		238						
Weaning weight	12	532	6	446	8	461						
Adj. weaning weight - 180 days		528		483		474						
Weaning score												
Cond.	12	1.8	6	2.3	8	1.9						
Conf.	12	1.8	6	2.1	8	1.8						

* Based on number of cows placed in breeding pasture minus those removed for some cause other than being barren. If a cow that is removed is barren she is counted in the "cows bred" group.

Feed-lot performance Utah Agricultural Experiment Station 6/30/60

Breed	Hereford	Hereford	Shorthorn
Line	I	II	I
Sex	Male	Male	Male
Number on test	2	6	8
Average:			
Age on test	262 days	267 days	268 days
Initial weight*	532	530	577
Initial score			
Cond.	2.2	2.1	1.6
Conf.	2.9	1.6	1.6
Days on test	115	116	116
Gain (Total)			
Average per calf	298	298	295
Average daily gain	2.59	2.56	2.56
Efficiency of feed utilization			
Lbs. TDN/100 lbs. gain	369	391	455
Final weight	831	828	872
Final score			
Cond.	2.0	2.4	1.6
Conf.	2.0	2.6	1.9

*Average of 3 weekly weights

Young Animals on Feed

Purebred 6/30/60

	Hereford Line I		Hereford Line II		Shorthorn Line I	
	Number individually fed	Number group fed	Number individually fed	Number group fed	Number individually fed	Number group fed
Bulls	2		6		8	
Heifers		8		15		6
Steers		4		9		6

Land, Physical Facilities, and Equipment Used 6/30/60

Item	Number	Actual Cash Value	Percentage Used For Breeding Project
Land - Panguitch	155 acres	$31,000	90
Land - Logan	269 acres	80,000	80
Shed, yards	5 units	60,000	90
Metabolism building	1 unit	60,000	5
Laboratory equipment, chemical		1,500	100

WASHINGTON STATE UNIVERSITY

I. Station: Washington Agricultural Experiment Station, Pullman, Washington

II. Project Title: Improvement of beef cattle by selection and mild inbreeding within lines of the Hereford, Angus, and Shorthorn breeds

III. Personnel:

Experiment Station:
C. C. O'Mary and M. E. Ensminger

Graduate Student:
Donald Vance

U. S. Department of Agriculture:
R. T. Clark, Coordinator

IV. Nature and Extent of Work Done This Year:

1. Body Measurements of Cows and Their Relationship to 180-Day Adjusted Weights of Calves

Body measurements were obtained on 16 Shorthorn cows. Those measurements were length of foreshank, length of rump, and forearm circumference. These measurements were correlated with the 180-day adjusted weaning weight of their calves. This was an attempt to determine whether the relationship would hold as previously had been determined for the Angus cows. Table 1 shows that the length of foreshank was negatively correlated with the weaning weight of the calf. This was exactly in the opposite direction

Table 1.--Simple correlation coefficients between various body measurements of 16 Shorthorn cows and weaning weights (adjusted to 180 days) of their calves

Variables	Mean	Correlative Coefficient
y (180-day weaning weight)	420 lbs.	-
X_1 (length of foreshank)	18.77 cm.	-.52
X_2 (forearm circumference)	48.28 cm.	.31
X_3 (length of rump)	54.85 cm.	-.001

from the findings of the work on the Angus cows. The Shorthorn cows definitely were of different body types. Some were very short-legged in relation to their size while others were quite long-legged and of lighter weight. The length of rump was not correlated with weaning weights of the

calves in Shorthorns. The forearm circumference was the only one of the three measurements which tended to go in the same direction as previously determined on Angus. Further work should be done on this but at present it appears that these measurements are not reliable estimates for determining weaning weights of calves. The fact that the Angus were a more homogenous group might explain in part some of the differences. The means of the various measurements of Angus and Shorthorns are given in table 2 in order to indicate the differences in measurements of the cows within the two breeds.

Table 2.--Comparison of body measurements between Aberdeen-Angus and Shorthorn cows

Variables	Mean	
	Angus	Shorthorn
No. of animals	20	16
Length of foreshank	18.05 cm.	18.77 cm.
Forearm circumference	44.80 cm.	48.28 cm.
Length of rump	45.25 cm.	54.85 cm.

2. Fifteen bulls and 23 heifers were placed on experiment to compare three systems of performance testing. All of the bulls and seven of the heifers were individually fed an all-pelleted ration. The remainder of the heifers were group fed eight to a group. The systems of performance testing compared were (1) a time-constant test of 150 days with all animals starting and finishing at the same time; (2) a weight-constant test in which the bulls were tested from 500 to 800 lbs., and heifers from 500 to 750 lbs.; and (3) an age-constant test of 150 days' duration beginning when the animals reached 243 days of age. At the beginning of the time-constant test the bulls ranged in ages from 168 to 229 days. Their weights ranged from 334 lbs. to 568 lbs. The heifers ranged in ages from 163 days to 243 days and in weights from 250 lbs. to 508 lbs. Analyses of variance showed no significant difference between the three tests on rate of gain for either bulls or heifers. Correlation coefficients of average daily gain with feed efficiency for the bulls on the three management systems were as follows: (1) time-constant, -.21; (2) weight-constant, -.38; and (3) age-constant, -.58. The correlation coefficient obtained on the age-constant test was significant. Correlation coefficients of average daily gain and feed efficiency for the heifers were -.75, -.62, and -.68, respectively, for the three systems. These did not differ significantly.

3. Forty-nine head of young beef cattle were used in the 1959-60 testing program to compare the relationship between rate and efficiency of gain in the time-constant test and weight-constant test in which the weight was broken down into 100-pound increments. All animals were individually fed on a pelleted 50 percent roughage ration. The correlation coefficients were calculated between feed efficiency and rate of gain on the bulls for

the 150-day time-constant tests, and between 100-pound weight increments as follows: 500 to 600, 600 to 700, and 700 to 800 pounds. Table 3 indicates these correlations. The same correlation coefficients also were determined on the heifers; however, the weight-constant test started with the 400- to 500-pound increment.

Table 3.--Correlation coefficients between feed efficiency and average daily gain within 100-pound increments in bulls

Weight Increments	Correlation Coefficient	D.F.	Levels for Significance
(Lbs.)			
600-700	-.74	10	.71 at 1% level
700-800	-.82	12	.66 at 1% level
800-900	-.81	4	.81 at 5% level
Time-constant 150-day period	-.46	15	.48 at 5% level

Table 4.--Feed efficiency and average daily gain within 100-pound increments in heifers

Weight Increments	Correlation Coefficient	D.F.	Levels for Significance
(Lbs.)			
400-500	.15	10	.57 at 5% level
500-600	-.45	16	.46 at 5% level
600-700	-.59	18	.56 at 1% level
700-800	.16	5	.75 at 5% level
Time-constant 150-day period	-.28	32	.35 at 5% level

V. Summary of Progress and Conclusions to Date:

Body measurements between Shorthorn cows and the adjusted weaning weights of their calves have failed to substantiate earlier findings in Angus.

It appears that correlations between feed efficiency and rate of gain are much higher when either age or weight are used as beginning and ending points than when a time-constant beginning and ending test is used.

Application of Findings

Measurements of the cow as taken appear at this time to have no immediate practical application for predicting weaning weights of calves.

Prediction of feed efficiency based on rate of gain appears to be more accurate on either an age- or weight-constant test than on a time-constant

test. The selection of a specific weight increment of 100 pounds appears to be more satisfactory than a 150-day test period for predicting feed efficiency from rate of gain. The disadvantage is that animals must be weighed at specific times rather than all animals being weighed at the same time.

VI. Work Planned for the Future:

The W-1 project at this station is being revised and plans have not been decided definitely upon.

VII. Publications and Manuscripts:

Hafez, E. S. E., M. E. Ensminger, and W. E. Hamm. 1959. Morphological and physio-chemical studies on dwarf Herefords. J. Agr. Sci. 53(3):339-345.

Hafez, E. S. E., E. H. Rupnow, C. C. O'Mary, and M. E. Ensminger. 1959. Carcass characteristics in the homozygous Hereford dwarf. Amer. Soc. Anim. Prod. West. Sect. Proc. 10:XIII-1-6.

Hafez, E. S. E., E. H. Rupnow, C. C. O'Mary, and M. E. Ensminger. 1959. Carcass characteristics in the homozygous Hereford dwarf. (Abs.) J. Anim. Sci. 18(3):1166.

O'Mary, C. C.
1959. Crossbreeding for profit. Breeders' Gaz. 124(9):28-29.

O'Mary, C. C. 1959. Selecting beef for herd improvement. Breeders' Gaz. 124(10):14-15.

O'Mary, C. C. 1959. Feed efficiency--key to beef feeding profits. Breeders' Gaz. 124(12):14,23.

O'Mary, C. C. 1959. Pelleted feeds for beef cattle. Feed Age 9(11):36-40.

O'Mary, C. C., T. L. Brown, and M. E. Ensminger. 1959. Correlation of cow measurements to 180-day adjusted weaning weights of their calves. (Abs. 28.) J. Anim. Sci. 18(4):1471.

O'Mary, C. C., and M. E. Ensminger. 1959. The occurrence of albinism in registered Hereford beef cattle. (Abs. 6.) J. Anim. Sci. 18(4):1462.

O'Mary, C. C., D. W. Vance, and M. E. Ensminger. 1959. Comparison of three systems of performance testing beef cattle (Abs. 13.) J. Anim. Sci. 18(4):1465.

Vance, Donald W. 1959. Evaluation of certain performance tests in beef calves. M. S. Thesis. State College of Washington. Pullman.

Bennett, Douglas Dee. 1960. Relationship of feed efficiency and rate of gain in specific increments in growing beef cattle. Undergraduate thesis for partial fulfillment for graduation with highest honors. Washington State University. Pullman.

O'Mary, C. C. 1960. Milk production in beef cattle affects weaning weight of calves. Feed Age 10(4):48-51.

Cattle Inventory
Purebred

PROJECT SUMMARY
Washington Agricultural Experiment Station

Breed	Angus	Hereford	Shorthorn
Line	Eileenmare	1	1
Station	Pullman	Pullman	Pullman
Bulls (12 mos. or over)	12	6	10
Cows (2 yrs. or over)	26	30	24
Heifers, yearlings	10	11	7
Bull calves	12	11	11
Heifer calves	9	12	10
Percentage used for breeding project	100	100	100
Estimated cash value	$27,000	$25,000	$20,000
Grades	None	None	None

Young Animals on Feed
Purebred

	Angus	Hereford	Shorthorn
	Number individually fed	Number individually fed	Number individually fed
Bulls	6	2	8
Heifers	11	14	8
Steers	0	0	0

Additions to Land, Physical Facilities, and Equipment Used

	Number	Actual Cash Value	Percentage Used for Breeding Project
Bull sheds	2 only	$2,000	100

Cow Production Data[1/] Washington Agricultural Experiment Station

Breed	Angus	Hereford
Line	Eileenmere	1
Cows bred to calve as 2-yr.-olds	0	2
Calves born from 2-yr.-olds		
Alive	0	2
Dead	0	0
Cows bred to calve at 3 yrs. & up	26	28
Calves born from 3-yr.-olds & up		
Alive	23	24
Dead	1	0
All calves born		
Alive	23	26
Dead	1	0
Total	24	26
Calves weaned	23	25
Percent calf crop[2/]		
Birth	92	87
Weaning	88	83

	Bulls		Steers		Heifers		Bulls		Steers		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Average:												
Birth weight	9	63.7	3	57.7	11	60.9	7	70.0	5	66.0	14	64.7
Weaning age	235		198		224		222		-		218	
Weaning weight	9	530	3	359	11	415	7	528	-		13	422
Adj. weaning wt. - 180 days	417		331		347		435		-		363	
Weaning score Conf.[3/]	9	13.3	-		11	11.9	5	13.6	-		14	12.0

1/ 1959 calves.
2/ Calculated as a percent of cows exposed.
3/ Score based on: 16 = Fancy; 13 = Choice; 10 = Good.

Cow Production Data[1/] (Continued) Washington Agricultural Experiment Station

Breed	Shorthorn					
Line	1					
Cows bred to calve as 2-yr.-olds	0					
Calves born from 2-yr.-olds						
Alive	0					
Dead	0					
Cows bred to calve at 3 yrs. and up	24					
Calves born from 3-yr.-olds & up						
Alive	23					
Dead	1					
All calves born						
Alive	23					
Dead	1					
Total	24					
Calves weaned	21					
Percent calf crop[2/]						
Birth	96					
Weaning	88					

	Bulls		Steers		Heifers		Bulls		Steers		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Average:												
Birth weight	11	75.5	3	68.7	9	68.2						
Weaning age	231		206		230							
Weaning weight	10	536	3	429	7	443						
Adj. weaning wt. - 180 days	429		384		359							
Weaning score Conf.[3/]	10	13.6	-	-	7	13.0						

1/ 1959 calves.
2/ Calculated as a percent of cows exposed.
3/ Score based on: 16 = Fancy; 13 = Choice; 10 = Good.

UNIVERSITY OF WYOMING

I. Station: Wyoming Agricultural Experiment Station, Laramie, Wyoming, and Gillette Experiment Station, Gillette, Wyoming

II. Project Titles:

W. S. 655 Criteria for improving effectiveness of selection in beef cattle

W. S. 610 A study of the significance of head form in beef cattle

III. Personnel:

Experiment Station:

G. E. Nelms, C. O. Schoonover, P. O. Stratton, C. P. Stroble, J. O. Tucker, and permanent and temporary farm laborers and graduate students

U. S. Department of Agriculture:

R. T. Clark, Coordinator

IV. and V. Nature and Extent of Work Done This Year and Summary of Progress and Conclusions to Date:

W. S. 655 - Criteria for improving effectiveness of selection in beef cattle. Performance data were collected as called for in the project. The possibility of increasing the accuracy of selection for meatier type sires by a simple measurement was tested. Data involving 97 beef animals were analyzed to study the relationship of the left metacarpal to muscling indicators. Two muscling indicators were used--area of rib eye and depth of round. All metacarpal measurements were taken from x-ray radiographs. Although it was possible to predict rib eye area and depth of round with approximately 99 percent accuracy, tests of significance for individual b's indicated that weight and breed exhibited a very strong influence upon the muscling indicators (table 1.) Age and age × weight had a lesser but significant effect on depth of round.

Table 1.--Regression coefficients

Variables	Y_1 Rib Eye Area	Y_2 Depth of Round
Hereford	6.98	21.3
Angus	6.86	20.5
Shorthorn	5.85	21.1
Live weight	0.028	0.05
Bone volume estimate	-0.027	-0.01
Age in days	-0.015	-0.13
Age × weight	0.010	0.05
Live weight squared	0.049	-0.11

The following generalities were drawn from this study:

1. There is a distinct breed influence on the general form of the cannon bone.

2. There is ample variation within breeds to allow for selection of the meat-type animal within each.

3. In this study, the larger rib eye area and depth of round are associated with a smaller bone volume estimate when the effects of breed and weight are removed.

4. The data indicate that when weight is held constant the younger animals have larger rib eye areas and round measurements.

In our work with freezing semen from young bulls, the data have been analyzed for the first two breeding seasons. The following generalities seem warranted from the study.

1. In the population studied, semen from Hereford bulls cannot be frozen from as young an animal as in the Shorthorn and Angus breeds. This observation may be chance in that the number of bulls considered was small.

2. Insemination per conception is greater in virgin heifers than in aged cows.

3. It appears that the morphology of the sperm, especially the protoplasmic droplet, is of considerable importance in evaluating semen from young bulls.

4. It would appear that present tests available are adequate for evaluating semen from young bulls.

5. Carcass data on the first calves conceived are encouraging. All animals slaughtered from sires previously selected for carcass traits were above average when compared to contemporary animals.

There are 14 calves on the ground this spring from sires selected for carcass desirability. Only one of the calves is from Hereford semen. The entire Shorthorn herd will be bred A.I. on the first estrus this spring. In addition, twelve grade Herefords and all replacement heifers will be bred A.I.

Data are complete on the progeny of the Hereford bull used in cooperation with the Oregon station. The data are summarized in the following tables.

Table 2.--Performance data - 1959 calves

	Oregon Sire		Wyoming Sires	
	Bulls	Heifers	Bulls	Heifers
Number	9	9	12	5
180-day weaning weight	357	314	340	365
Average daily gain	2.33	1.73	2.30	1.86
Feed/pound gain	7.10	7.90	6.84	7.25
Score	6.6	7.2	7.0	7.5

Table 3.--Carcass data on bull calves

	Oregon Sire	Wyoming Sires
Number	8	9
Carcass weight	460 lbs.	464 lbs.
Carcass weight/day of age	1.19	1.16
Length loin	59.7 cm.	59.1 cm.
Length body	112.7 cm.	111.3 cm.
Area rib eye	10.59 sq. in.	10.69 sq. in.
Depth round	31.2 cm.	30.6 cm.

Two abnormal calves were produced from the Oregon bull. One heifer calf was abnormal in size. It had a final weight of 416 pounds (12 months). The calf was unthrifty, and had a tendency for bloat throughout the feed test. The other calf apparently possessed an inherited lethal.

A study was undertaken last fall to determine composition of body gains. Body composition was determined using tritiated water. Thirty heifers were individually fed and body composition determined at the initiation of the feed test and at 28-day intervals. In addition, the blood is being analyzed for creatinine, acid and alkaline phosphatase, glutamic-oxalactic and glutamic pyruvic transaminases, total plasma protein, and urea. The blood constituents will be correlated with total gain and gain in lean body mass.

Detail body measurements were taken at birth on all calves. It is our intent to correlate these measurements with measurements taken on the carcass. X-ray radiographs at birth, weaning, and yearling age, of the left metacarpal bone are being taken in order to find an indicator of the bone content of carcass.

W. S. 610 - A study of the significance of head form in beef cattle

Head forms have been accumulated on a group of Hereford heifers. Data are being collected on performance of these females. As soon as these data are complete, the relationship of head form to performance will be determined.

Application of Findings

By freezing semen from young bulls and then evaluating their carcasses, the progeny test is avoided. This research provides a tool by which experimenters can obtain accurate heritability estimates in a comparatively short time. In addition, it provides the breeder of seed-stock with a practical approach to the selection of meatier beef animals.

The use of the metacarpal bone as an indicator of meatiness has possibilities. If its predictive value can be worked out with greater precision, it will be of considerable value as a selection tool.

VI. Work Planned for the Future:

The project will be continued as outlined. A more detailed study of growth will be undertaken. It is felt that a better understanding of growth would solve many problems related to the production of meatier animals.

VII. Publications and Manuscripts:

Hallman, L. E. 1959. Factors affecting postweaning performance in beef cattle. M. S. Thesis. University of Wyoming. Laramie.

Stratton, P. O. 1959. Short-cut to meat-type steers? Farm J. May 1959:59.

Nelms, G. E. 1960. Inheritance and heritability of some economically important traits. Univ. Wyo. Div. Anim. Sci. Beef Cattle Short Course. Feb. 2, 1960.

Nelms, G. E., and P. O. Stratton. 1960. Research in beef breeding at the University of Wyoming. Stockman June:.

Salsbury, S. W. 1960. An evaluation of frozen young beef semen. M. S. Thesis. University of Wyoming. Laramie.

Salsbury, S. W., G. E. Nelms, and P. O. Stratton. 1960. The utilization of frozen semen from young beef bulls. Amer. Soc. Anim. Prod. West. Sect. Proc. 11:XI-1-6.

Turner, E. E. 1960. The bovine metacarpus: Criterion of meatiness. Ph. D. Thesis. University of Wyoming. Laramie.

Cattle Inventory PROJECT SUMMARY
Purebred Wyoming Agricultural Experiment Station

Breed	Angus	Shorthorn	Hereford	Hereford
Line	Laramie	Laramie	Laramie	Gillette
Station	Laramie	Laramie	Laramie	Gillette
Bulls (12 mos. or over)	2	1	3	4
Cows (2 yrs. or over)	29	27	43	29
Heifers, yearling	9	7	11	8
Bull calves	22	14	24	11
Heifer calves	6	10	15	12
Percentage used for breeding project	100	100	100	100
Estimated cash value	$13,325	$11,225	$19,100	$13,500

Cow Production Data

Breed	Shorthorn	Angus
Line	Laramie	Laramie
Cows bred to calve as 2-yr.-olds	6	5
Calves born from 2-yr.-olds		
Alive	5	3
Dead	1	1
Cows bred to calve at 3 yrs. and up	24	28
Calves born from 3-yr.-olds and up		
Alive	22	24
Dead	1	3
All calves born		
Alive	27	27
Dead	2	4
Total	29	31
Calves weaned	25	25
Percent calf crop		
*Birth	90	82
**Weaning	83	76

	Bulls		Steers		Heifers		Bulls		Steers		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Average:												
Birth weight	14	69	1	83	10	66	11	54	2	48	12	53
Weaning age		180		184		186		185		181		186
Weaning weight	14	378	1	333	10	350	11	365	2	340	12	354
Adj. weaning wt. - 180 days		378		328		342		363		340		344

* Live calves/number of cows in breeding pasture
** Calves weaned/number of cows in breeding pasture

Cow Production Data (Cont'd) Wyoming Agricultural Experiment Station

Breed	Hereford	Hereford
Line	Laramie	Gillette
Cows bred to calve as 2-yr.-olds	13	9
Calves born from 2-yr.-olds		
Alive	12	7
Dead	1	2
Cows bred to calve at 3 yrs. and up	33	34
Calves born from 3-yr.-olds and up		
Alive	25	24
Dead	2	1
All calves born		
Alive	37	31
Dead	3	3
Total	40	34
Calves weaned	37	31
Percent calf crop		
*Birth	80	72
**Weaning	80	72

	Bulls		Steers		Heifers		Bulls		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Average:										
Birth weight	21	75	1	66	15	70	17	77	14	70
Weaning age		167		177		172		169		164
Weaning weight	21	329	1	352	15	320	17	388	14	328
Adj. weaning wt. - 180 days		347		357		329		404		353

*Live calves/number cows in breeding pasture

**Calves weaned/number of cows in breeding pasture

Feed-lot Performance Wyoming Agricultural Experiment Station

Breed	Angus		Shorthorn		Hereford		Hereford	
Line	Laramie		Laramie		Laramie		Gillette	
Sex	M	F	M	F	M	F	M	F
Number on test	11	10	12	10	19	10	17	13
Average:								
Age on test	200	209	199	208	184	202	199	194
Initial weight	358	377	390	370	367	374	425	353
Days on test	168	168	168	168	168	168	168	168
Gain per head								
Total	357	259	393	253	377	300	350	243
Av. daily gain	2.13	1.54	2.34	1.50	2.24	1.78	2.08	1.45
Efficiency of feed utilization # TDN/100# gain	475	492	476	532	435	470	-	-
Final weight	715	636	783	623	744	674	775	596
Final score Conf.	7.1	8.0	7.4	7.9	7.2	7.3	7.0	7.2

Young Animals on Feed
Purebred

	Hereford		Shorthorn		Angus	
	Number individually fed	Number group fed	Number individually fed	Number group fed	Number individually fed	Number group fed
Bulls	19	3	12	0	11	0
Heifers	10	0	10	0	11	1
Steers	0	0	0	1	0	2
Grade						
Bulls	0	3	0	0	0	0
Heifers	1	3	0	0	0	0
Steers	0	1	0	0	0	0

Wyoming Agricultural Experiment Station

Land, Physical Facilities, and Equipment Used

Item	Number	Cash Value	Percentage Used For Breeding Project
Farm truck	1	$2,700.00	30
Dry-lot sheds, feed room, and working corrals	1	4,840.00	100
Floor to silage pit		1,000.00	100
Calculator	1	850.00	80
Hereford bull	2	800.00	100
Feed scales	3	60.00	50
Specific gravity tank	1	58.00	50
Farm pick-up	2	4,072.00	50
Surplus tractors	2	200.00	50
Lantern slide projector	1	256.00	40
Strobonar unit	1	153.05	50
Electric typewriter	2	970.00	50
Hereford twin calves	2	222.50	100
Cattle water	1	71.68	100
Toledo meat scale	1	299.75	40

Arizona - Dr. Pahnish

Dr. Pahnish reviewed the analytical work and data analyses that he is doing. The calf crop from the cooperating herd at San Carlos continues to increase. In 1960 it reached 89 percent. It was 68 percent in 1957 at the start of the project. Pahnish expanded on his plans to test mothering ability in the San Carlos cow herd. He also is proceeding with the completion of the Boice Brothers cooperative research.

During the discussion of this report, Bogart was informed by Pahnish that so far no attempt has been made to correlate blood and liver values with gain.

California - Dr. Rollins

Dr. Rollins hopes to complete his analysis of the growth data before going on sabbaticatical late in the summer of 1961. His research on the so-called double cervix has permitted clearer description and definition of the various types. For the most part this condition does not interfere with reproduction.

The private corporation that was established to handle Record of Performance data on private herds in California is progressing favorably with all data being handled under IBM systems.

Rollins then reviewed the cooperative testing work being done in Colorado, Mississippi, and Oklahoma. Despite the difficulties involved in a project of this character, most of the original objectives have been accomplished. Rollins is in the process of writing up the early crossbreeding work and will submit this to the Journal of Animal Science. He described current results on negative correlations obtained on $\frac{\text{round}}{\text{heart girth}}$ ratio with percent fat in the 12th rib.

Future revisions of the work will include techniques to obtain better measures of efficiency of feed utilization and a revised crossbreeding project.

Colorado - Dr. Stonaker

Dr. Stonaker informed the committee that Fort Lewis is now completely under the Agricultural Experiment Station and that this new working relationship should lead to higher productivity. He is considering project revisions to be offered possibly within the year.

He reviewed the work on size and efficiency of feed utilization and the correlated responses. He presented a plea for body composition studies on all feed tests and that more group efficiency-of-feed data be obtained, not just rate of gain alone.

Discussion followed as to approaches that we should pursue in testing. Stonaker concluded by expressing the opinion that some increase in mature size of the whole beef cattle population would be beneficial.

Hawaii - Dr. Cobb

Dr. Cobb described the current status of the Hawaii project including the expansion of University facilities. He referred to the meats data he has gathered and expressed the view that taste panels should have few variables to measure.

Idaho - Dr. Christian

Dr. Christian reviewed new work on semen evaluation of young animals and facilities to be built that will enhance the current program. In this new research he intends to stress early freezing evaluations. He is starting a study of cow production data covering the past ten years.

Discussion followed on Christian's "Application of Findings" paragraph in his annual report.

Montana - Professor Willson

Fred Willson referred to the type experiment and stated that cooperating breeders are changing their sights as to the kind of bulls they are selecting for use in the Show herd. He expressed the opinion based on four years of work that Angus calves go on feed easier than Herefords. He reviewed the cooperative test at Miles City that is dovetailed in with his type study. He is summarizing the results of the first four years of this study.

Urick then discussed the Havre project, particularly the tests that are being run comparing experiment station cattle to commercial breeders' cattle. He expressed the view that it is doubtful if we can select feeder cattle that are capable of producing significantly better carcasses when fattened. He would like to place station bulls in other herds on a sound comparative and controlled basis. Urick referred to the limitations of using small closed lines, but despite these limitations improvement in the lines seems to be taking place. He stressed the need for larger lines with more effective selection than has been possible with small lines.

On yearling heifer weights a heritability estimate of 0.36 has been obtained. Urick stated that very good cooperation was being obtained with ranchers. The early data have tended to cause the ranchers to change their views on what is a useful animal.

Flower suggested that we should be testing for mothering ability as transmitted through the sires and to determine whether this is independent of inherent growth.

Nevada - Dr. Foote

In commenting on Nevada's work, Dr. Foote referred to the plans of the station to hire a new geneticist. Progress has been made in summarizing the rat work.

New Mexico - Dr. Holland

Dr. Holland stated that the station has changed to a pelleted ration containing a high percentage of roughage.

Cooperative testing has been initiated with Mississippi through the use of three bulls from the old New Mexico line. The meats work is being expanded at Las Cruces. In work with industry they have encouraged private breeders to set up their own central testing station.

Dr. Holland is starting data analysis on progenies of bulls that have been tested. He suggested that in future meetings of the Technical Committee we should have discussion of such topics as efficiency of feed utilization and really thrash out single topics.

Blackwell has submitted the first of a series of papers based on IBM analysis which he completed in the Denver office.

Adjourned for lunch.

Oregon - Dr. Bogart

Dr. Bogart opened up the subject of the analytical work he is doing in summarizing for publication the growth and efficiency data coming from his project.

U. S. Range Livestock Experiment Station - Dr. Kieffer

Dr. Kieffer reported for the Range Station and covered the cooperative work with the American Breeders' Service, especially in heat detection. He described the efforts that are being made to set up a line that will be selected on carcass merit.

Utah - Dr. Bennett

Dr. Bennett described the progress being made with Shorthorn and Hereford lines. He is studying the differential growth rates by lines by periods. He noted that he has had good success in feeding a pelleted ration. Carcass tests of lines have been initiated this year.

On-the-farm testing is increasing and has been quite successful. Over 600 bulls are being tested this year. The Utah station has emphasized to breeders that information of this nature has its greatest use when used within the herd.

Bennett still hopes that biochemical approaches will be useful in determining true genetic differences in stocks.

Washington - Dr. O'Mary

Dr. O'Mary prefaced his remarks on the Washington project by discussing the question of measuring efficiency and expressed the view that a time-constant system is less efficient in measuring true utilization than a weight-constant system. Discussion among the committee followed.

Dr. O'Mary served notice of project revisions he planned to submit.

Wyoming - Dr. Nelms

Dr. Nelms concluded the state reports by outlining his station's frozen semen work in cooperation with Colorado State University. This phase of the work is in the preliminary stages and has not been very successful to date but is worthy of exhaustive study. He pointed out the need to determine the causes of nonfreezability of semen, for on this criterion alone some highly desirable ROP bulls were poor risks.

With respect to carcass determinations, it seems perfectly feasible to use young bulls as subjects to determine carcass merit of lines. On the subject of techniques, Wyoming is interested in determining true body composition and particularly the amounts of muscle tissue in the live animal.

Business Session

Chairman Bennett called on Dr. C. F. Sierk of State Experiment Stations Division for remarks. Dr. Sierk expressed pleasure in "coming home." On committee work, he said we should be sure to stress points that are of significance to the Committee, and to make sure sufficient time is allotted.

He reviewed the proposed "humane treatment of stock" laws and offered to send copies to Committee members; also, copies of the proposed changes in beef grades to be offered by Agricultural Marketing Service.

He raised the question as to whether we needed concerted carcass project work in conjunction with our over-all breeding improvement projects.

Dr. E. J. Warwick expressed pleasure in being able to attend a W-1 meeting, and referred to points that he had discussed throughout previous sessions of the conference.

Discussion took place on the apportionment of Planning and Coordinating Funds for this meeting.

Christian moved that 28 percent of the total expenses be borne by each station to cover its representative's costs. Motion failed for lack of a second.

Cobb moved that the stations share equally in the expenses in the amount above the Planning and Coordinating Fund. Bogart seconded.

Stonaker moved to amend the motion to read that the equal sharing be changed to read that after transportation costs have been deducted the stations will share costs equally. After discussion, Stonaker withdrew his amendment.

Motion carried.

The Chairman then called for project revisions.

Rollins introduced the California crossbreeding experiment now under way and asked that it be recognized as part of the California contribution to W-1.

Christian moved that if the majority of the Technical Committee approves the California crossbreeding project it will stand accepted, with approval or disapproval to be sent by each station to the Committee Chairman and comments on the project to be sent to Rollins. Bogart seconded the motion. Motion carried.

O'Mary introduced two proposed revised projects as suggested contributions from the Washington station. Christian moved the same motion as in the case of California but that the two revisions be considered as separate projects. Nelms seconded the motion. Motion carried.

Stonaker moved that the Miles City station technical committeeman, J. R. Quesenberry, be confirmed as incoming Chairman. Pahnish seconded the motion. Motion carried.

Discussion then took place on the time and place of meeting in 1961.

Bennett reminded the Committee of a previous statement that, since Utah had waived its invitation for 1960 in view of the joint meeting in Oklahoma, the initial Utah invitation be reconsidered and the 1961 meeting be held in Logan. O'Mary followed by inviting the Committee to meet in Pullman.

Stonaker moved that we meet at Pullman, Washington, in 1961 since the Western Section meetings will be at Moscow, Idaho. Christian seconded. Motion carried.

Stonaker moved that the Chairman of W-1 obtain the dates of the Western Section meeting and schedule the W-1 meeting immediately after the Western Section meetings. Willson seconded. Motion carried.

Bennett discussed a publicity release relative to this meeting and introduced a statement prepared by the Publicity Specialist at Oklahoma State University along with the Committee on Publicity.

Cobb then presented the Resolutions Committee report.

> BE IT RESOLVED, That the W-1 Technical Committee express appreciation to Oklahoma State University for the hospitality accorded and the excellent facilities provided for the joint meeting of the NC-1, S-10, and W-1 Technical Committees in 1960. A special expression of gratitude is extended to members of the Animal Husbandry Department and all who directly assisted them in their efforts which have made the 1960 joint meeting a success.

Cobb moved that the resolution be passed. Bogart seconded. Motion carried.

> BE IT RESOLVED, That the W-1 Technical Committee recommend to the Administrative Adviser that he urge the Western Directors to request the Administrator of Agricultural Research Service to implement consideration and ultimate activation of the proposed National Animal Germ Plasm Research Laboratory. This resolution is made with the understanding that the proposed laboratory will be organized as a new facility that will not affect the financial support of existing projects.

Cobb moved that the resolution be passed. Pahnish seconded. Motion carried.

> BE IT RESOLVED, That Regional Coordinators be urged to prepare a procedure for joint cooperation among stations whereby those stations in their regions who can and desire to participate in the establishment and maintenance of an interregional genetically stable control herd may be assisted in doing so. Should such a program be feasible the regional coordinators would be asked to assist in the accumulation, randomization, and distribution of foundation stocks.

Cobb moved that the resolution be passed. Stonaker seconded. Discussion by Wheeler, Stonaker, Bogart, and Rollins followed.

Rollins moved that the resolution be amended as follows:

... That the Regional Coordinators explore the possibilities of genetic control stocks with the other coordinators and report on suggested procedures to the Committee as a whole at next year's meeting.

Stonaker made the point that no reallotment of existing funds would be involved to get this thing going. Bogart seconded the amendment. Amendment carried. Motion as amended carried.

Director Wheeler spoke on the subject of funds for the project and presented the following table covering Regional Research Fund proposals for W-1 as approved at the last meeting of the Directors.

ALLOTMENT OF REGIONAL RESEARCH FUND TO W-1

1960-61

Arizona	4,000
California	5,300
Colorado	8,300
Hawaii	4,100
Idaho	5,300
Montana	6,600
Nevada	5,400
New Mexico	8,300
Oregon	8,300
Utah	6,600
Washington	5,600
Wyoming	7,100
Planning and Coordinating	2,300
Total	77,200

1961-62

No increment	77,200
3.5 million increment	82,300*
7 million increment	82,300*
14 million increment	82,300*

*This is a restoration figure

Director Wheeler reminded the Committee that it has the privilege of reconsidering changes at any time in state allotments. He reviewed the favorable reactions obtained from the ten-year review report of W-1 presented to the Committee of Directors and commended those who had participated with the Regional Coordinator in the preparation of this report, particularly the Chairmen for 1959 and 1960.

Chairman Bennett then called on the Coordinator for remarks.

Dr. Clark commented on the growth of the project resulting in frequent inquiries from within as well as outside of our country. He stated that the representatives of Agricultural Research Service had particularly enjoyed the cooperation with the several stations that had utilized to good advantage the Denver IBM facilities, particularly New Mexico through Knox and Blackwell, Oregon through Bogart, Montana through Willson and Urick, California through Gregory, and Arizona through Pahnish and Roubicek.

With Dr. Brinks now stationed in Denver, plans are developing to expand this phase of the project data analysis and get into some of the fundamental aspects. Dr. Clark was particularly pleased to see the draft of the New Mexico manuscript by Blackwell since such studies could lead to appropriate statistical designs in the handling of other blocks of data at several stations.

Dr. Clark referred to the selection study now under way at Miles City and commended Drs. Rice and Kieffer for the prodigious piece of work they are doing in completing the necessary relationship charts on all inbred lines.

He referred to the drouth conditions at Miles City and how this had necessitated downward revisions in inventory and yet preservation of current projects. He expressed thanks to the Committee for their increasing appreciation of the necessity for advancing basic research.

Meeting adjourned.